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A TECHNOLOGICAL DESCRIPTION OF NURSING UNITS

BY

PEGGY OVERTON (C)

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

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FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "A Technological Description of Nursing Units," submitted by Peggy Overton in partial fulfilment of the requirements for the degree of Master of Health Services Administration.

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ABSTRACT

The main purpose of the study was to empirically describe the work or tasks of selected types of nursing sub-units in hospitals, using a concept of technology which included: the characteristics of patients; the nature of nursing techniques; and the types of task interdependence. The need for the investigation was seen from two perspectives: first, technology has been proposed by organizational theorists as an important variable for explaining organizational processes and differentiating organizational varieties; and second, descriptions of nurses work to date have been incomplete, and have not constituted a comprehensive enough base for comparative analysis of nursing specialities.

The unit of analysis was the nursing sub-unit. Seven types of units were included, namely, paediatrics, obstetrics, rehabilitation, intensive care, auxiliary, psychiatry and surgery. A total of 71 sub-units in eight hospitals in Edmonton participated.

After pretesting, a 34 item questionnaire was given to a random sample of five nurses from each unit. The response rate was 95.5%. Data analysis was performed on unit scores, obtained by averaging nurses' responses on each item for each unit. Statistical procedures used were factor analysis, analysis of variance and Q technique.

Factor analysis resulted in the identification of three independent technological factors describing nursing unit work, which

were labelled, uncertainty, instability and variability. Each of these factors was characterized by distinctive types of patients, nursing techniques and task interdependence. In addition, the three factors corresponded with the three areas of nursing practice known as care, cure, and coordination. Significant differences between some of the types of sub-units were shown in terms of their degree of uncertainty, instability, and to a lesser degree their variability. From the application of Q technique, three categories of nursing units were identified, and these were described in terms of their degree of indeterminancy of their technologies. Intensive care units were alone in one category and were the most indeterminant. Psychiatric and auxiliary units appeared next in indeterminancy, and paediatrics, obstetrics, surgery and rehabilitation units appeared together with generally less indeterminant technologies. However, these categories were not independent. The results of oblique Q analysis indicated that obstetrical, paediatric, and rehabilitation units, had elements of their work in common with psychiatric and auxiliary units, and surgical units had similarities with intensive care units.

The findings suggested that basically two relatively different patterns were occuring in nursing tasks. First, a high crisis-intervention,technical, patho-physiological orientation to nursing tasks as found primarily in the intensive care units. Second, a longer-term behavioural modification emphasis, where nurses function as relatively independent, therapeutic agents as found mainly in the psychiatric and auxiliary units. Theoretically, these patterns in nursing tasks have potential implications for improving planning for nursing manpower requirements, so that nursing expertise may be provided

to match the characteristic needs of patients. However, the results of this research have primarily descriptive value for the tasks performed by the nursing sub-units included in the investigation.

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CHAPTER I

INTRODUCTION

Organizational theorists have suggested that the type of work being done in organizations, that is, an organization's technology, has potential importance for differentiating organizational varieties and for explaining organizational processes (Hall, 1972, p. 161; Perrow, 1967, p. 195; Thompson, 1967, p. 19; Woodward, 1965, p. 51). To date, empirical research focussing upon the work done in nursing organizations in hospitals has been sparce. Measures of nurses tasks have tended to be incomplete for describing work processes (Stevens, 1972, p. 13) and have not constituted a comprehensive enough base for comparative analysis of nursing organizations. The aim in this investigation was to apply concepts of technology delineated by organizational theorists to nursing sub-units within hospitals in an attempt to 1) describe the tasks of these sub-units, and 2) differentiate between them in terms of their technologies.

In industrial firms, Woodward (1965, p.51) was one of the first researchers to infer relationships between an organization's system of production and its associated structural pattern. In initial investigations, she found associations between technological complexity and structural characteristics of style of management, shape and form of the organization, and type of labour force. In later studies, Woodward (1970, pp. 4-16) discovered associations between production task, technology and mechanisms of control. Still within the industrial

setting, the inter-relationships between technology, structure and organizational size have been explored by Hickson, Pugh and Pheysey (1968) and Child and Mansfield (1972). In these studies, technology was defined in terms of work operations and the structural characteristics investigated were, concentration of authority, personal versus impersonal control mechanisms and structuring of activities. Technology was found to be of greater significance at the workflow level of the organization than at the level of the total organization. In addition, correlations between technology and structure were generally overwhelmed by correlations between structure and organizational size. Wedderburn and Crompton (1972, pp. 133-151) also described complex relationships between organizational technology and workers' attitudes toward various aspects of their work. In a case study comprising two different technological situations, these authors found that the nature of the work, to some degree, influenced the work environment and the control systems, and these factors in turn were associated with workers' level of strike activity, degree of absenteeism, attitudes toward work tasks and job interest.

In organizations providing services to people, as opposed to manufacturing products referred to in the literature as human service organizations, the characteristics of technology and their relationships to other organizational variables have not been neglected. Perrow (1967), as a forerunner, argued that the nature of technology, particularly the nature of clients attending human service organizations, has implications for the design of effective organizational structure. Defining technology in terms of routine and non-routine tasks, he described its relationships with power, workers' discretion and mechanisms for co-ordination.

Other researchers have used Perrow's conceptual framework as a starting point for empirical studies. In health and welfare agencies, Hage and Aiken (1968), for example, found correlations between the degree of routineness of work, the type of organizational goals, and structural variables of centralization of power and degree of formalization, stratification and complexity. Bell (1967) also described relationships between the complexity of tasks and span of control within selected departments in a community hospital.

In general, the results of the empirical research exploring the relationship of technology to structure have demonstrated that routine or non-complex technologies tend to be found in association with bureaucratic structures, and non-routine or complex technologies in association with non-bureaucratic structures. The exact nature of the relationship between the two variables and the extent to which other variables might intervene is unclear from the varying research methodologies used and from the results of the research. The kind of relationship described, however, would appear to depend upon the specific dimensions of technology conceptualized and operationalized and the particular structural characteristics being investigated (Child & Mansfield, 1972, p. 370).

Nevertheless, some theorists postulate that organizational success is directly dependent upon meshing structural design to the type of technology of the organization (Lawrence & Lorsch, 1967, p. 158; Woodward, 1965, p. 51). Hunt (1970, p. 251) suggested that some organizations might match structure to technology as a natural evolutionary process, however, he pointed out that this argument should not preclude administrators from conscious planning of organizational

design on the basis of their technology to enhance organizational effectiveness. According to the contingency model of Lawrence and Lorsch (1967, p. 158) no one best way is seen to organize, however, Lawrence and Lorsch indicated that work arrangements should be examined in relation to the degree of predictiveness, certainty and/or routineness of tasks and the organization's dominant concern or competitive issue. The organization should then be designed to reflect the particular task dimensions needed to achieve higher performance. Morse (1970) investigated workers' feelings of competence as a potential outcome of organizations where there was a "good fit" between the nature of the task and structural design. Findings in this study suggested that task and structure were simultaneously linked to or interdependent with both workers' motivations and effective task performance. In an investigation of the inter-relationships among manageability of tasks, participativeness of supervisory style and organizational effectiveness, Mohr (1971) found that manageability of tasks was negatively associated with participativeness (as he had expected), but consonance between these two variables was not related to effectiveness when this was measured in terms of workers' attitudes. These studies would suggest that further investigation is required into the degree of dependency of organizational success upon the matching of organizational structure to the type of technology.

Attempts to relate these above aspects of organizational theory to nursing organizations are relatively few to date. Elsberry (1972) described power relations in hospital nursing and Smith (1972) reviewed the implications of various approaches for organizational analysis, including Perrow's approach, in hospitals. Kovner's study (1966) is the only systematic investigation known to this author of relationships

between technology, goals and structure,within different types of nursing units within hospitals,from an organizational theory viewpoint.

From a broader sociological perspective there have been several other approaches to describing the technology, or in a more general sense, the work done by nurses. A predominant approach has tended to be through role definition (Anderson, 1973, pp. 101-106), describing what the nurse expects from herself in terms of her own role conception and what is expected of the nurse from other persons such as patients and doctors. For example, the role of the nurse as a mother-surrogate was described by Schulman (1960, pp. 528-537),and as an expressive role rather than an instrumental role by Skipper and Leonard (1965, p. 31).

Another approach has been to describe nurses' work within the framework of social practice theory. A social practice is one in which practitioners use social or social-psychological techniques to help their clients (Wooldridge, Skipper & Leonard, 1968, p. 5). Two types of nursing practice are defined by Wooldridge et al., namely, care and cure practices. Within the organizational context, Mauksch (1966, pp. 109-137) differentiated three areas of nursing practice, care, cure and coordination. Both the role definition and social practice approaches are limited when attempting to investigate the work of nursing sub-units or organizations as a whole since their focus is narrow. Generally speaking, they are specific to the behaviours of individuals, and focus upon what individual nurses do or ought to do in their interaction with patients, rather than upon the total organization's work.

From the nursing perspective, a common approach to describing nurses' work has been by delineating in the form of position descriptions specific lists of tasks and detailed activities; see, for example,

Driscoll (1973). As with the other approaches, position descriptions are limited in their value in organization analysis because they refer to the work of individuals. Also, in general, they have not been specifically designed to permit comparative analysis within and between nursing organizations, and are not sufficiently standardized to cross organizational boundaries.

There is evidence in the nursing literature to suggest that nursing is becoming increasingly specialized (Lambertsen, 1968, p. 89) and that traditional "generalist" approaches to manpower requirements prevalent in hospitals and schools of nursing are no longer appropriate (Simms, 1973, pp. 89-122). Within hospitals, in-patient areas are normally divided into specialized nursing units,and the number of these specialized units is increasing following a trend in physician specialization. Some nursing administrators have expressed the opinion that the nature of the work of the nursing personnel in each of these specialized units varies considerably yet they are perplexed by the lack of identification of the exact similarities and differences between these units, and which administrative strategies might best be used to accomodate such discrepancies. In the author's experience, within many hospitals, nursing units in general have the same or similar formal organizational structure, procedures, rules and policies. Also, adaptive mechanisms to allow for differences in technology tend to be informal and generally without systematic pre-planning.

Some recognition of the need to differentiate various types of nursing units in terms of their technology is demonstrated by a trend to develop workload indices for appropriate manpower allocation (Aydelotte, 1973, p. 31; Ryan, Barber & Marciante, 1975). These indices are

primarily aimed to identify the amount of work of nursing units so that comparisons may be made between units, within units, and through time periods. To date, however, these indices have shown limited value not only in adequately describing nurses' work in totality but also in differentiating nursing units, because they are most applicable where work can be measured in terms of observable routine procedures (for example, medical-surgical units) ,and do not take into consideration non-routine tasks and/or the nuances of socio-psychological aspects of nurses work (Stevens, 1972, p. 13).

The Need for the Study

The specific need for this investigation can be viewed from several perspectives. First, there would appear to be sufficient evidence from the organizational theory viewpoint that organization technology is a variable of considerable importance as a starting point for exploring other organizational variables such as structure and effectiveness, and is thus worthy of further investigation. There is little evidence in the literature, however, of the application of this type of conceptual framework to nursing organizations. As a first step then, a need is seen to apply concepts of technology to nursing organizations to attempt to describe and compare them.

Second, from the nursing administration perspective, with increasing specialization of nursing units, a more systematic means of describing similarities and differences between the work of nursing units is required. These descriptions could potentially provide a basis for greater understanding of the complexities of the various nursing specialities and may point to clearer directions for the future in terms of improved planning for manpower and other types of resource allocation

problems.

In the long-term, contingent upon adequate descriptions of nursing unit work, and differentiation between nursing units in terms of technology, relationships between technology, structure, effectiveness, and other organizational variables could be investigated. The outcomes of such investigations might comprise more inclusive and valid design of nursing sub-units to improve consonance between the nursing services provided and the needs of patients.

Major Concepts of Technology Described by Organizational Theorists

The purpose of this section is to outline the main concepts of technology which have been delineated by organizational theorists in order to provide a basis for defining the concept of technology for this investigation. The major concepts are described in relation to the level of the organization to which they are applicable, the dimensions included within each concept and the boundaries of the total concept.

Approaching technology from the level of the total organization, Woodward (1965, p. 42) conceptualized technology in industrial organizations according to the type, size and complexity of the production firm's output. She based her definition of technology on the aspects first described by Dubin in 1959,as comprising two dimensions: the tools, instruments, machines and technical formulae basic to the performance of work; and the body of ideas which expresses the goals of the work, its functional importance, and the rationale for the methods employed. A continuum of technological complexity was developed ranging from the simplest form of production known, "production of units to customers' requirements", to the most complex, "continuous flow production". This continuum represented the sequence of historical development of various

types of production systems and also stages of increasing control over the production process. It did not represent a scale of technological progressiveness.

Harvey (1968, p. 248) criticized the ordering of this complexity continuum since he saw the continuum in reverse. To him, the scale of unit, mass and process modes of production,were not arranged in order of technological complexity but rather moving towards technical simplicity. Using Woodward's work as a point of departure, Harvey postulated that not only the form of the technology was important, but also the amount of change within a form. He described a technological dimension ranging from diffuseness to specificity as an indicator of the frequency of production change.

Later, still approaching technology at the level of the total organization, Woodward (1970, pp. 3-18) incorporated dimensions of change and variety in production within her framework. At this stage, she assumed a task analysis approach, defining the production task as the type, quantity and quality of the goods to be produced along with the rates of production. Technology and the production task were seen as interdependent since neither could be defined without reference to the other.

Thompson (1967, pp. 14-24) was concerned with the technical rationality of complex organizations. This he defined as the extent to which activities within organizations, based upon man's beliefs about cause and effect relationships, are judged to produce the desired outcomes. Thompson (1967) stated that "perfection in technical rationality requires complete knowledge of all cause/effect relations plus control over all of the relevant variables" (p. 24). Conceptualizing technology

in terms of the total organization, Thompson described three technological varieties. These categories were intended to be broad enough to incorporate the types of technology found in complex organizations in modern society. The focus within each category was upon the conversion process to transform inputs to outputs.

A "long-linked" technology was described as involving serial interdependence of actions to the degree that act Z could only be performed after successful completion of act Y, which rests upon act X. The mass production assembly line would be an example of an organization with this type of technology. The process works best when only one standard product is being made repetitively and at a constant rate.

A "mediating" technology applied to organizations which were concerned primarily with the linking of clients or customers who were or who wished to be interdependent, for example, banks or post offices. The technology involved dealing with multiple clients, distributed in time and space, requiring operations to be extensive yet in standardized ways.

In the situation of "intensive" technology, a variety of techniques are used during the transformation process. The selection, combination and order of application of the techniques are determined by feedback from the object being transformed. Thompson described the general hospital as an example of this type of technology, indicating that an emergency admission to a hospital requires a combination of services -- x-ray, nursing, medical, pharmacy, and so forth; yet, the exact combination of technology can only be determined from on going information about the patient.

Technology was also conceptualized in terms of work processes or transformation processes by Hickson et al.(1968, pp. 378-381).

However, technology was approached at the workflow level rather than at the level of the total organization. A concept of operations technology was developed consisting of two dimensions: 1) production continuity, which was essentially the same as Woodward's classification of production output; and 2) workflow integration. This latter dimension comprised three sub-concepts: the degree of mechanization and automation of equipment; the sequencing of operations in terms of workflow rigidity; and the means employed in the organization for assessing the performance of operations.

Using transformation processes as the focus, Whistler (1970, p. 15) developed a concept of information technology. He was primarily interested in identifying the impact of computers on organizations. Information technology was defined as the sensing, coding, transmitting, translating and transformation of information. Whistler saw information technology as a technology of control in that, he believed older technologies were an extension of man's muscle and thereby man's tools, yet the newer technologies were seen as an extension of man's brain with the potential of being his partner or even controlling him.

To this point, the concepts of technology described for the most part originated from research based on manufacturing firms. Perrow (1965, pp. 910-971; 1967,pp. 195-197; 1970,pp. 50-91) wanted to develop a technological framework which would be applicable not only in traditional production industries, but would be meaningful in human service organizations. Technology was viewed in terms of the techniques performed upon basic material which is to be altered in some way by the organization. In his early work, Perrow(1965, pp. 913-915) described the process whereby basic material is taken into the organization, a series of acts

performed upon it, and the material is altered in a desired fashion. The raw material or object on which action is performed may be a living being, a symbol, or an inanimate object. For an act to qualify as a technique it should be known to have a cause and effect relationship with the object and rely on feedback from the object, so that the consequences of the act can be assessed. Further, the technique should have demonstrated reliability and should be communicable so that persons may learn and master it. These characteristics are in keeping with Thompson's descriptions (1967, p. 14) of technical rationality in that they are based upon beliefs about cause and effect relationships and necessitate feedback from the object being processed.

Perrow (1970, p. 75) described the work performed in organizations according to its degree of routineness. Two conditions were defined as essential for work to be considered routine: first, there must be well established techniques which are sure to work; and second, these must be applied to essentially similar raw materials. In these circumstances, there is little uncertainty about what is to take place and little variety in tasks to be performed. Where work is non-routine, there are few well established techniques and therefore little certainty about methods. In addition, raw materials are not standardized, thus, a variety of tasks is being performed. Although polar situations of routine versus non-routine organizations were described, the technological variable was primarily seen as a continuum consisting of two dimensions: the nature of the raw materials, and the nature of the techniques for transforming raw materials. These two dimensions form a stimulus-response set for individual workers: the stimuli are the raw materials upon which the workers must operate; and the responses are the actions

performed by the workers in transforming the materials to the desired output.

Perrow (1970, p. 78) maintained that in human service organizations it is the nature of the raw materials which is the technological criterion for differentiating organizations rather than the nature of the techniques. Three critical characteristics of raw materials were described: the degree to which raw materials are or are not understood; their variability and their instability. In relation to the degree to which they are understood, Perrow indicated that it is the "state of the art" of analyzing prominent characteristics of raw materials which determine the specific techniques to be used. Where raw materials are well understood they can be better controlled and there will be greater efficiency in the application of techniques: Where materials are not well understood, outcomes from transformation processes will tend to be unpredictable. Where workers see materials as stable and uniform, it is implied that they can be acted upon in a standardized way. Where they are perceived as unstable and variable this implies that continuous adjustments must be made in transformation processes. Perrow suggested that organizations attempt to standardize their raw materials in order to reduce variability and minimize exceptional cases (Perrow, 1970, p. 78).

The critical characteristic of the techniques used in the transformation process is the nature of the search process undertaken to find the appropriate technique, especially when exceptions occur. The search process or search behaviour may be logical and analytic, for example, where techniques can be applied with predictable outcomes. At the other extreme, it may be unanalyzable when outcomes are unpredictable and the search relies upon intuition, inspiration, guesswork, or some similar

unstandardized procedure (Perrow, 1967, pp. 195-196).

The dimensions of Perrow's technological variable are summarized in Figure 1.

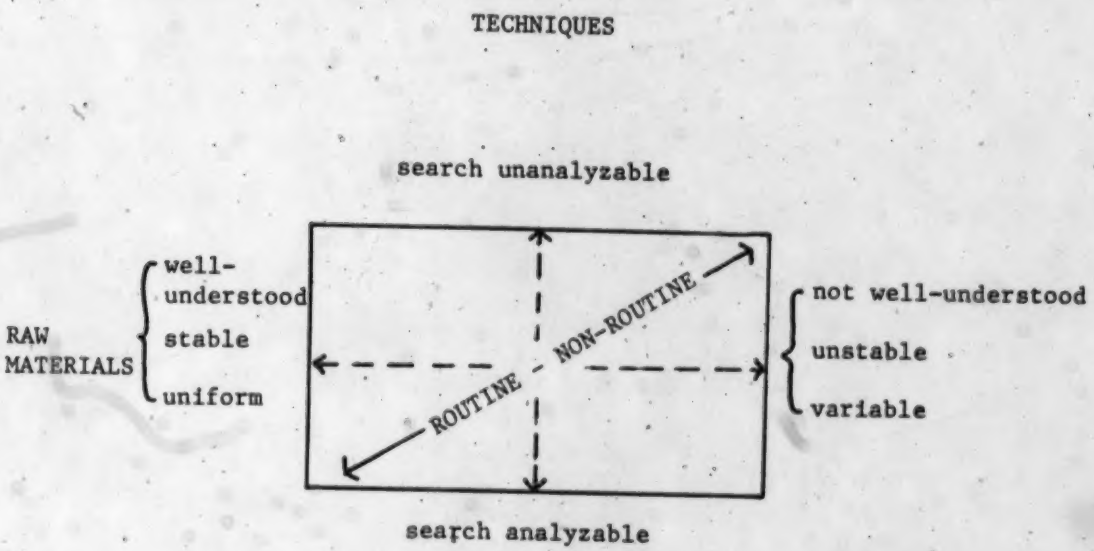


Figure 1. Perrow's Technological Variable (adapted from Perrow, 1967, pp. 195-196).

All the concepts of organizational technology described appear to incorporate not only the hardware and equipment used in the work, but also the thought processes, rationale and ideas behind the use of techniques. Perrow is no exception in this regard since he believed organizational technology rests upon knowledge about the raw materials. He indicated that increased knowledge of the raw materials may lead to the perception of a greater variety of possible outcomes which, consequently, leads to the need for more knowledge about the nature of the raw materials. An organization with increasing knowledge in one area

may wish to try out new materials about which it will require more knowledge. When there is no expansion in the variety of materials when knowledge has increased in existing areas, problem analysis is facilitated and the transformation process may be routinized or standardized. According to Perrow (1967, p. 197), it is the frequency with which a worker's knowledge appears to be inadequate to them which is important. Where knowledge is perceived to be inadequate, the worker will tend to employ unprogrammed search behaviour to find appropriate ways of transforming the material.

It is important to note that although Perrow viewed technology in relation to the total organization as a whole, his actual perspective is through the eyes and cognition of individual workers. When discussing critical characteristics of raw materials, for example, he indicated that it is the way the organization (made up of individual workers) perceives the materials in terms of the degree to which they are understood, their variability and their instability,which is important, rather than the actual physical or psychological characteristics of the materials themselves (Perrow, 1967, p. 197). Woodward (1970, p. 14) criticized Perrow's work on the basis of his defining an organization's technology in terms of workers' perceptions. She indicated that expressing technology in a manner which is in itself "social" is confounding when trying to investigate its relationship with social structure. Although Woodward agreed with Perrow's approach of identifying exceptional cases and variability, she suggested that these dimensions should be described by additional means to workers' perceptions.

Boundaries of the Technological Variable

The researchers of organizational technology appear to be cognizant of the necessity to clearly define the boundaries of the technological variable so that it may be maximally separated from other organizational variables. From the literature there would appear to be considerable ambiguity regarding which dimensions of the work process ought to be included with the technological variable and which dimensions ought to be part of organizational structure (Hunt, 1970, pp. 243-246).

Recognizing grey areas between concepts of technology and structure, Woodward (1970, p. 34) differentiated the two variables by describing technology as the starting point for the identification of the nature of the social system needed to cope with the uncertainty and unpredictability arising from the variability in production task. To some degree, however, the concept of technology for the workflow level described by Hickson et al. (1968, pp. 378-381) included the arrangements for getting the work done, for example, the sequencing of work, the degree of interdependence of tasks, and the mechanisms for re-routing work. Perrow (1967, p. 195) indicated that the particular dimensions to be included as part of the technological variable depend to some extent on which aspects of the organization are being investigated. He distinguished between technology and structure by describing technology as the individual worker acting upon raw material directly to change it, whereas structure is the individual worker interacting with other workers to try to change raw material. Coordination was defined as an aspect of task-structure which may occur through varying mechanisms dependent upon the nature of the raw materials and techniques being used. Three kinds of coordination were described: planning, programming or feedback.

Where technology is routine, coordination is likely to be by planning or programming, where it is non-routine, coordination will rely upon feedback mechanisms (Perrow, 1967, pp. 198-199).

Concept of Technology for This Investigation

Technology was conceptualized from the viewpoint of sub-units at the workflow level of organizations, and included selected aspects of technology defined by Perrow (1967, pp. 195-196), Hickson et al. (1968, pp. 380-381), and Thompson (1967, p. 15).

Organizational technology was defined in terms of the actions an individual performs on an object, living or otherwise, with or without the aid of tools or mechanical devices in order to bring about changes in raw materials (Perrow, 1967, p. 197). Inherent in this definition were the basic characteristics of raw materials, the knowledge or body of ideas behind actions, and the rationale for methods employed.

The concept of technology comprised three specific dimensions.

1) The nature of raw materials. Critical characteristics of the materials were: a) the degree to which they were or were not understood; b) the degree of instability; and c) the degree of variability (Perrow, 1967, pp. 195-196).

2) The nature of techniques used in transforming raw materials. Critical characteristics of the techniques were a) the degree to which search processes were analyzable/unanalyzable; and b) the mechanisms for handling exceptional cases (Perrow, 1967, pp. 195-196).

3) The type of task interdependence. This dimension included a) the degree of dependence of particular segments of the sub-unit's task on other segments (Hickson, 1968, pp. 380-381) and b) the type of feedback (Thompson, 1967, p. 15) and coodination mechanisms involved.

CHAPTER II

PERTINENT LITERATURE

The purposes in presenting this literature are: 1) to outline the predominant approaches to the measurement of technology in organizational research; and 2) to describe technological aspects of hospital nursing organizations within the larger context of human service organizations.

Initially, an overview of the most pertinent empirical research investigating organizational technology is given, with particular emphasis upon describing the operationalization of the concept of technology, the types of measures used, the reliability and validity of measures where reported, the units of analyses, and the kinds of organizations from which samples were drawn. Since the research methodologies used in these studies were diverse, and in most investigations a variety of other organizational variables were included, it is difficult to draw meaningful comparison between studies. The approach then in this overview is essentially descriptive.

The second portion of the literature review is concerned with describing hospital nursing organizations within the overall context of human service organizations. Functions of human service organizations are briefly outlined. Distinctive characteristics of the technology of human service organizations are then discussed along with detailed features of hospital nursing technology, in relation to raw materials, techniques and task interdependence. An introduction to selected

structural characteristics of nursing organizations is provided, as is a review of that literature comprising attempts to describe nursing units in terms of technological similarities and differences.

An Overview of the Empirical Research on Organizational Technology

Industrial Organizations

As part of a large scale study to determine characteristics of organizational success, Woodward (1965, pp. 7-50) investigated production systems in 91 manufacturing firms. The unit of analysis was the total organization. An initial background survey was performed by a team of researchers to obtain historical-descriptive data on the organizations from management personnel and documents. A nine category complexity scale was used to measure technology and 80 of the firms were found to have one predominant type of production system. The scale grouped the firms into three essentially nominal categories: unit, batch, and continuous processing, according to their technological complexity and order of chronological development. The reliability and validity of the methodology were not reported upon.

In a case study following this initial survey, the technological complexity scale was further refined. A variable called production density was defined and operationalized in terms of the increasing rate of production along the scale. Measurement of this variable was performed by timing the interval between the completion of one component of work and the completion of the next piece of work (Woodward, 1965, p. 188).

Later, Woodward (1970, pp. 20-28), using the unit-batch-process scale as a starting point, investigated a number of other technological dimensions focussing upon the theme of variability. These included:

1. Variation in production range. This was measured by counting the number different products made in a firm during a specific period of time.

2. Standardization of components. This was an attempt to measure the degree of interchangeability of components, and was calculated by the ratio of actual applications of components to various products to the number theoretically possible.

3. Number of production stages. For measurement of this characteristic, the number of separate assembly or conversion stages in the manufacturing process was counted.

4. Definition of the product. For each of the firms, a description of the product in terms of its uniqueness or standardization was obtained.

A number of problems were reported in this above investigation due to the fact that none of the measures appeared to be applicable across a wide range of firms.

Zwerman (1970, p. 19) replicated Woodward's earlier work in 55 firms in Minneapolis. The methodology was essentially the same as in the original study. Date collection was performed by interviewing top management personnel. The reliability of the methodology was checked out by having the interviewer first gather data on two firms not to be included in the study. In addition, documents were examined to assess the validity of the information obtained by interview. Also, one firm was investigated more intensively than the others, but no discrepancies were observed. It was assumed from these procedures that the methodology was reliable and valid (Zwerman, 1970, pp. 169-172)

In another large scale study aimed at investigating a range of organizational variables, Hickson et al. (1968, p. 381) developed a measure of technology at the workflow level, focussing

specifically upon operations technology. Fifty-two diverse organizations including factories, commercial offices, public utilities, retail stores, and others were investigated. Forty-six of these organizations were drawn by random sampling from an official list of registered employers (N not reported), stratified by product or purpose and by size. The size of the organizations ranged from 250 to 25,052 employees (mean 3,370).

Operations technology, defined as the techniques that an organization uses in its workflow activities, was divided into four sub-concepts: production continuity, automation of equipment, adaptability of workflow, and evaluation of operations. For the measurement of production continuity, Woodward's unit-batch-process scale was used, but modified to comprise 10 categories with an underlying continuum assumed (Hickson et al., 1972, p. 23). The degree of automation of equipment was measured by a five category scale adapted from Amber and Amber (1962, pp. 2-7) indicating the degree to which first energy and then information is provided by machines rather than by man. An automacity mode, the most frequent level of automacity of the workflow equipment, and the range of automacity of the equipment were estimated (Hickson et al., 1968, p. 282). Adaptability of workflow was measured by an eight item scale which attempted to identify what happens to the workflow when there is a change or interruption in pattern, such as when there is an emergency or when equipment fails. These eight items were combined and used as a single measure of workflow rigidity since they had demonstrated some internal consistency. The interdependence of segments of the workflow was also considered of relevance to

adaptability. A scale consisting of three items was designed ranging from "mutually independent" through "largely independent yet complementary production" to "sequential integration". Specificity of quality evaluation was assessed by a three-point classification. The items differentiated according to whether the organizations used personnel evaluation only, or partial measurement of outputs, or measurements of virtually all outputs by comparing them against a standard (Hickson et al., 1968, pp. 282-283).

Data collection was performed with the aid of standard schedules and by interviewing chief executives and department heads. The results of the use of the scales for estimating automation, workflow adaptability and quality evaluation, were found to be highly intercorrelated. Principal component factor analysis was applied to the data and a large first factor explaining 58% of the variance in the 52 firms was found which was named workflow integration. This dimension was then defined as "the degree of automated, continuous fixed-sequence operation in the technology" (p. 284). Predictive validity of the measure was assessed by studying the relationship between workflow integration and labour costs. A negative relationship was predicted and this was confirmed in the analysis. Although the measure discriminated between firms there was a tendency for service organizations to polarize low on the scale, and for manufacturing organizations to polarize high on the scale (Hickson et al., 1968, pp. 284-285).

Child and Mansfield (1972) replicated the work of Hickson et al. incorporating some modifications. The methodology was essentially the same as in the original study. The analysis of the

responses (from 82 organizational heads and departmental managers) from six types of business industries gave different results than those obtained by Hickson et al. Two dimensions, specificity of evaluations and interdependence of workflow segments, were found to be unrelated to the other three dimensions of workflow rigidity, automacity and workflow integrations. These latter dimensions, however, were found to be highly intercorrelated (Child & Mansfield, (1972, pp. 384-386).

Human Service Organizations

In a study of the relationships amoung technology, goals and social structure, Hage and Aiken (1968) investigated routineness of work as one dimension of technology to represent the concept of Perrow (1967). The unit of analysis was the total of organization and the data was collected in 16 health and welfare agencies in a large mid-western metropolis. The types of organization included were those providing rehabilitation and a variety of psychiatric services. The size of the organizations ranged from 20 to 600 employees.

Data collection was by interviewing a random sample of job occupants stratified by level, department, and ratio of professionals to non-professionals. The reason for this was that the authors suspected that the degree of routineness of the work might vary at different levels, within different departments, and between professionals and non-professionals. The stratified sampling design resulted in a range of number of interviews from 11 in the smallest agency to 62 in the largest.

The four questions used for the measurement of routineness of work were first designed by Hall (1963). Factor analysis

procedures were used to check whether the dimension of routineness was distinct from other organizational variables, such as job codification, rule observation and job specificity. Details were not reported as to whether the factor analysis was performed on individual workers' responses as opposed to organizational responses.

Because the unit of analysis was the total organization, data from the individuals interviewed in each organization were aggregated to form an overall technological measure. Since the organizations were perceived as a collection of social positions rather than as an aggregate of individual persons, mean technological scores for social positions were calculated. An organizational score of technology was calculated by averaging the means of all social positions. These procedures resulted in equal weight being given to each social position in the organization and, according to Hage and Aiken (1968, p. 368-369), prevented the top management positions from being underweighted. Within a scale of 1 to 4 (non-routine to routine) organizational scores 1.31 to 2.45 indicated that the organizations were comparatively homogeneous and non-routine. The homogeneity was thought to be due to the fact that all agencies provided similar types of services.

To examine the validity of the use of the one aggregated organizational score of technology, the data were analyzed using one way analysis of variance, according to organizational level, occupational group and organization. Occupants at higher levels in the organization and those working closely with clients had tended to report more non-routine work and the authors suggested for example, that nurses were more likely to describe their work as non-routine than psychiatrists

because of the large portion of their time which is spent with clients. However, no significant differences were found by levels of organizations and occupational groups, yet differences by organizations were significant (Hage & Aiken, 1968, pp. 369-370).

Bell (1967), in an investigation of the determinants of span of control, examined complexity of tasks in various departments in a community hospital. The unit of analysis was the hospital department. An index of task complexity was designed which took into account: the degree of predictability of work demands; the amount of discretion workers exercise; the extent of workers' responsibilities; and the number of different tasks they performed. Data were collected (from 186 employees) by a variety of methods including: responses to five items on a questionnaire (predictability); interviewing supervisors (responsibility); and interviewing employees (different tasks). No information about the reliability and validity of the measures was reported. Departmental scores of technology were calculated by averaging the technological scores of individual workers in each department.

As part of a larger study designed to investigate the determinants of style of supervision in organizations, Mohr (1971) examined the relationship of technology to participativeness of supervisory style. The analysis was based upon 144 work groups, from 13 local health departments selected randomly from health departments serving a population of greater than four hundred thousand persons. The work groups included a range of occupations, such as custodians, clerks, sanitation insepctors, public health nurses, dentists, physicians, and so on. Data collection was by mail questionnaire, with a response rate of 80%.

Technology was conceptualized in terms of the manageability of tasks and materials. This was an attempt, in keeping with Perrow's concepts, to isolate the predictability dimension of technology at the individual worker level. Predictability was further sub-divided into uniformity, complexity and analyzability. The actual work group score for manageability of tasks was calculated by averaging three quantities:

1. a classification of job titles by the investigator into eight levels of operations technology on the basis of uniformity, complexity and analyzability.

2. written descriptions of each group's task by the supervisor, which were rated by consultants in terms of materials technology.

3. the supervisor's responses to a questionnaire item on each of the three sub-dimensions of manageability, that is, uniformity, complexity and analyzability.

The third measure did not correlate highly with the first two measures but was retained in the study to ensure local input into the measurement of technology since the first two measures relied heavily on the opinion of outside experts.

Task interdependence was also measured as a separate aspect of technology by two questions to both subordinates and supervisors; however, little relationship was found between manageability of tasks and task interdependence (Mohr, 1971, pp. 449-451).

Lynch's approach (1974, pp. 338-355) to the study of technology was quite different from the research reported so far, since her primary objective was to delineate empirically dimensions of technology, and to determine if these could be reliably and validly measured for the academic library setting. She was not concerned with exploring the relationship between technology and other organizational variables, but believed that the immediate need was to develop more sophisticated

technological measures. Technology was conceptualized according to Perrow incorporating 1) the frequency of exceptional cases, 2) the nature of search behaviour and 3) the degree of knowledge available. Routineness of work as defined by Hage and Aiken (1968, p. 366), and task interdependence as defined by Lawrence & Lorsch (1967, p. 91) and Hickson et al. (1968, p. 282), were also included in the investigation.

Data were collected from 15 departments in three academic libraries. This included departments concerned with reference and circulation dealing mostly with clients, and departments concerned with book selection, acquisition and cataloguing, dealing mostly with materials. Data were obtained by a questionnaire comprising 88 items, to all full-time professional and clerical staff. A total of 521 questionnaires were sent out with a 73.5% response rate.

A technology scale was constructed by merging the data from the 15 departments and using factor analysis procedures, however, these procedures were performed on individual responses (n = 383) rather than departmental responses (n = 15). Six technological factors were found, three of these reflecting Perrow's technological construct: predictability of events; routineness of operations; and insufficient knowledge. The other three factors were related to overall routineness and task interdependence.

Second order factor analysis was carried out using varimax rotation. Three independent factors emerged, which were interpreted as equivalent to three dimensions from Perrow's conceptual framework, predictability, routineness and insufficient knowledge. These factors were then combined to form the Library Technology Scale. In the questionnaire, they were represented by a total of seven items. Task

interdependence emerged from the factor analysis as a structural variable, supporting Perrow's theory in this regard. However, the author pointed out that in this instance task interdependence was measured by workers' attitudes, whereas in previous research, for example, by Hickson et al. (1968, p. 283) objective measures were used.

Convergent and discriminant validity of the three scales, the Library Technology Scale, overall routineness and task interdependence, were examined using intercorrelation matrices. Other organizational variables included in the questionnaire for this purpose were job satisfaction, rules, morale and job autonomy. Reasonable convergent and discriminant validity was found in the Library Technology Scale, but overall routineness showed low discriminant validity and task interdependence low convergent validity (Lynch, 1974, p. 345).

Although the scale was developed using data from individuals as the units of analyses, it was used to compare the library departments to see if they could be differentiated in terms of their technology. For this purpose, department mean scores were calculated on the Library Technology Scale by averaging individuals' scores for each department on each factor. The mean scores were then ranked. The results showed that departments with similar functions clustered on the scale; for example, reference libraries had the lowest scores, the work being the least predictable, least routine and most difficult to learn; search departments were the opposite with the highest score. Analysis of variance was applied to the individual-response data to examine the significance of differences between the departments on the scale. The largest catalog department was selected as a reference group. The results indicated that 4 out of the 14 departments were significantly

different ($\alpha = .05$) from the reference group.

The various departments were also compared on each of the three dimensions separately. Some differences were observed; for example, some departments had the same mean technology score, but their scores were different for each of the dimensions. No distinct pattern in this regard was discernable (Lynch, 1974, pp. 346-348).

Some personal characteristics of individual workers were examined to see if these influenced their perceptions of their work. Variables considered of importance were 1) level of education, 2) whether or not the person was a supervisor and 3) and the length of time on the job. Based on analysis of variance, findings indicated that being a supervisor, or length of time on the job, made no difference to technological scores. However, scores were significantly different ($\alpha = .05$) for workers with various levels of education. In spite of these results, Lynch maintained that aggregation of the scores of all respondents in the department is the best reflection of the department's technology because the mix of levels of education of workers is, to some extent, dependent upon the technology of the departments (Lynch, 1974, pp. 348-349).

Although the above study demonstrated greater methodological emphasis than previous investigations, the study had some limitations. First, the intention was to develop a measure of technology for departments and to compare differences between these departments, yet the development of the technological scale, the estimates of validity and comparisons of departments were based upon the individual worker as the unit of analysis. This change in unit of analysis indicated inconsistency in procedure and it is not known to what extent the same

results might have obtained had the scale been developed on the basis of organizational scores of technology. Second, the results are limited in their generalizability and applicability to academic libraries.

Kovner (1966, p. 34) attempted to compare the work done in various types of nursing units within hospitals. Hospital nursing technology was defined according to Perrow's earliest formulations (1965) in terms of the techniques used for transforming patients. Technology was represented by two dimensions: variability of patients; and the predictability of techniques. The variability dimension was divided into two parts, stability and uniformity. Stability referred to the patient's condition, and included the patient's degree of illness, the frequency of patient emergencies, and the importance of the patient's condition as a work problem. Uniformity referred to how patients were perceived by unit members including the staff's evaluation of patients with varying medical and non-medical states. The predictability dimension was an attempt to identify the routine to non-routine aspect of work. It was sub-divided into complexity of processing and complexity of communication. Complexity of processing was concerned with the type of medical or nursing judgement used in decision-making and nurses' manual dexterity in relation to special tests. Complexity of communication related to the number and types of communications the nurses were involved in, and the degree of need for the nurses to have "communication ability" (Kovner, 1966, pp. 69-78). Because Kovner's work was restricted to the base provided in Perrow's earlier work, it did not include the investigation of the concept of analyzability of search processes.

Nursing units used for the Kovner study were those from 4

hospitals in a large city in the United States. The study hospitals were chosen primarily on the basis of size and medical-nursing school affiliation. Eight units were included in the investigation, ranging in size from under 25 to 45 beds.

Data collection was by questionnaire, a total of 296 nurses participated with a response rate of 96%. Although the questionnaire was designed to collect a wide range of data, including other organizational variables such as goals and structure, there were 12 items on the questionnaire directly relating to technology (Kovner, 1966, pp. 142-153). No information was given on the reliability and validity of the measure.

Three groups of nurses were included, professional, non-professional and professional nursing students. Because the number of nurses in each unit was small, sometimes as low as six persons in each group, scores for each question were adjusted to standardize the number of nurses in each unit. On the basis of the scores for predictability and variability, an index of relative complexity of technology of the units was calculated. On this scale, the eight units ranked from high to low as follows: intensive care; neurosurgery; medical teaching; acute psychiatry; rehabilitation (1); rooming-in; medical-surgical; and rehabilitation (2). Kovner indicated that in essence there were three categories of complexity of units: intensive care and neurosurgery rating high; medical teaching, rehabilitation (1) and acute psychiatry rating intermediate; and rooming-in, medical-surgical and rehabilitation (2) rating low (Kovner, 1966, pp. 78-79).

Conclusions Based on the Empirical Research

This review of the empirical research illustrates that

technology has been approached at different levels in organizations, has been operationalized in many different ways and measured by a variety of methods depending upon the particular kind of organization under investigation. Most of the research has been concerned with hypothesis-testing and the methodology for developing the measures of technology has not in general been reported in detail.

The research on technology in industrial organizations for the most part has been performed in Britain. The scale of the research was large and a multitude of organizational variables has been explored by teams of researchers. The organizations investigated have ranged in size from about 100 to 25,000 employees. Sample size has varied from 52 to 100 organizations; because of the large scale of the research, it was possible for study organizations to be selected by random sampling. The type of industries participating in the research has been a combination of service and manufacturing. Technology was initially operationalized in terms of the complexity and variability in production task and output of the total organization and measured by a nominal scale; later, through replication and further exploratory studies, technology was measured through ordinal scales at both the total organization and workflow level in terms of operations technology, including production continuity, automation, adaptability of workflow and performance appraisal. Data collection was by interviews with top management, observation, and reviewing documents using standardized information schedules. Differences between organizations were found, however, in some instances service and manufacturing firms would seem to have polarized on the scales.

In contrast to industrial organizations, the majority of the

research on technology in human service organizations has taken place in the United States and the studies have been on a smaller scale. Sample sizes have been generally smaller, ranging from 8 to 16,with the exception of one study,where the sample comprised 144 and organizations which were selected by random sampling (Mohr, 1971). In all except one study reported (Lynch, 1974), the participating organizations were concerned with the delivery of health and/or social services. The unit of analysis was the department, work group, or sub-unit within organizations in most instances. The sizes of the organizations were much smaller than in industrial organizations, the range in human service organizations being from 6 to 600 employees. The concept of technology employed has generally been considered multi-dimensional and has been based primarily upon the work of Perrow. This has been operationalized in a variety of ways, for example, as routineness of work, task complexity, manageability, predictability, and variability in raw materials. Data collection has mostly been at the level of the individual worker by questionnaire and/or interview. In some instances, respondents have been selected by random sampling. Usually, both prfessional and non-professional workers have been included. Questionnaire items or interview questions to tap the technological variable have ranged in number from three to twelve.

Factor analysis has been used by some of the researchers in developing the technological measures and the unit of analysis for this procedure has generally been the individual worker. This approach demonstrates inconsistency in methodology since the intention in the studies was to develop a measure of technology for total organizations or sub-units. This inconsistency would suggest that the measures can

be considered valid for comparing individual workers in terms of technology, but not necessarily considered valid for comparing units or departments.

Organizational scores of technology have been obtained by averaging the scores of individual workers within each department or sub-unit. Each question or item has generally been given equal weight, with adjustments being made in some cases for varying social positions and small numbers of employees. The effects of personal characteristics of workers such as level of education, length of time on the job, and social position,on workers' perceptions of their work have been examined by analysis of variance techniques. In one study,significant differences were found between workers' perceptions of technology with differing levels of education.

The reliability of various methodologies has not been reported in most instances and there is evidence of only one replication study, that of Lynch (1974) repeating Hage and Aiken's measurements of routineness of work, and task interdependence. Discriminant validity of the measure of technology was evaluated in two of the studies and construct validity in one investigation only.

The measurement instrument developed by Lynch (1974, p. 355) although valid for the library setting at the individual worker level, would require modification for applicability to other types of organizations such as nursing units. Little information was provided concerning the reliability and validity of Kovner's measurement instrument (1966, pp. 176-177), however, this questionnaire has the advantage of being specific to nursing units. The findings of this latter study are limited in their generalizability since only eight

nursing units were actually investigated.

Hospital Nursing Organizations Viewed within the Overall Framework of Human Service Organization

Functions

The primary function of human service organizations has been described as being,to alter and/or define persons' behaviour, attributes and social status in order to enhance their well-being (Hasenfeld & English, 1974, p. 1). Two major types of human service organizations were delineated -- those involved in providing services to change people, and those involved in processing people. People-changing organizations apply various techniques to their clients in order to bring about behaviour modifications. In processing organizations, persons' basic characteristics are not purposefully altered, but change in clients is brought about by allocating a certain public status to them,and by relocating them in a different set of social circumstances (Hasenfeld & English, 1974, p. 5).

Hospitals can be thought of as people-changing organizations, although procedures for processing or classifying persons might be one group of functions that the hospital performs. Processing of patients might predominate in selected departments within a hospital, for example, in the admitting or emergency department. Foote and Hatt (1958, p. 365), refer to industries such as medical care, education, research and recreation (which would include hospitals) as quinary industries. The common principle upon which these industries are based is that they are engaged primarily in the refinement and extension of human capacities.

Hospital nursing organizations are, for the most part, people-changing organizations since their foremost function, in keeping with

Foote and Hatt's definition of quinary industries, is to modify where possible patients' health states. Nursing organizations also perform processing functions in that they classify patients according to the type of nursing care they require. The classification process may be informal, for example, nurses have a tendency to continually attach labels to patients such as, "pre-operative", "post-operative", "acute", "chronic" and so on. On a more formal basis, there are patient classification systems for example, MacDonell, Brown and Johannson (1965) which are used by nurses in many hospitals to classify patients according to the level of nursing care required. These systems may be used daily, monthly or on a yearly basis.

The explicit functions of the nurse have not been clearly delineated although there have been many efforts made by the profession internationally, nationally, and within formal organizations and by individual nurses. A widely accepted definition which serves as a guidance for many nursing organizations is the one prepared by Henderson (1970, p. 15) for the International Council of Nurses in 1961:

> "The unique function of the nurse is to assist the individual, sick or well, in the performance of those activities contributing to health or its recovery (or to a peaceful death) that he would perform unaided if he had the necessary strength, will or knowledge. And to do this in such a way as to help him gain independence as rapidly as possible."

Technology

The technological characteristics of human service organizations which set them apart from industrial organizations relate to the level of determinancy of their technology, specifically, the degree of availability of knowledge about cause and effect relationships for bringing about desired change in raw materials. In contrast to

industrial organizations, human service organizations tend to be characterized by indeterminant technologies because 1) there is considerable uncertainty in the nature of techniques because of variability in raw materials, 2) techniques are unpredictable because of limited knowledge and lack of certainty about cause and effect relationships, and 3) there is difficulty in specifying desired outcomes in measurable terms (Hasenfeld & English, 1974, p. 280). In addition, human service organizations, such as hospitals, may be characterized by indeterminancy when there is lack of consensus or understanding between what patients' see as their needs in terms of services, and what services are seen by health professionals as being necessary. For example, a patient may not know what techniques are required to cure or care for him, yet a physicians may consider the patients' problem to be well understood and that the techniques can be applied with reasonable certainty of success.

Although human service organizations in general may have a high degree of indeterminancy of technology, Hasenfeld and English (1974, p. 13) suggested there may be considerable variation within and between them; for example, a general acute hospital technology is more determinant than a psychiatric hospital primarily because in the former patients tend to present physiological as opposed to psychological symptoms,and there is therefore less uncertainty when deciding which techniques to apply in general hospital settings than in psychiatric settings.

"Technology" is not a term which is frequently used in the nursing literature, and when it appears it tends to have negative connotations. Over the past fifteen years nursing leaders and educators

have denoted considerable dissatisfaction amonst nurses because their role is too limited to what is called in the nursing literature, technical nursing (Brown, 1966, pp. 176-203). This level of function is seen to involve basic, relatively routinized procedures, aimed at assisting patients with activities of daily living (bathing, walking and feeding), and performing standardized treatment procedures such as dressings, removal of sutures, giving medications. A higher level of functioning, that is,a professional approach,is seen as essential for improving patient care, emphasizing an enrichment of the narrow procedural role of the nurse to include enlarged nurse-patient relationships (Brown, 1966, p. 192). In a substantial sense this implies an expansion of nurses 'work from a somewhat routine technology to a technology which is considerably indeterminant. Lambertsen (1968, p. 93) implied nursing technology was indeterminant when she described professional nursing practice in terms of decisions which included uncertainty, unpredictability, and potential hazards to the safety of patients.

Raw Materials. Perrow (1967,p. 195) maintained that the raw materials in people-changing organizations are the persons presenting themselves for service; as such, these persons are a crucial factor in the organization's technology. In hospital nursing organizations, then, the raw materials are the patients admitted for care to each nursing unit. THese patients gain entrance to the unit by order of the physician and, generally speaking, the nurse has little control over which patients are admitted except by her indirect influence on the physician. In contrast to other workers in human service organizations such as, doctors, social workers, and physio-therapists, the nurse has no say in

the selection of her clients.

The characteristics of the persons to be changed and/or processed by the organization, particularly their degree of willingness to participate in the change program, may influence the degree to which organizations can reach their desired goals. For example, clients may have a strong resistence to being changed which would tend to make change techniques proposed by organizations ineffective. In addition, since clients have social values of their own, the organization maybe limited in the change techniques it can use by the value system prevalent in its social environment (Hasenfeld and English, 1974, p. 13). Roth (1974, p. 515), for example, indicated that organizations are sensitive to patients' social attributes, and staff evaluate patients on an individual basis and form responses accordingly. He found that personnel's perception of patients in terms of their social worthiness and legitimacy for services influenced the quality of services they received. Further, nurses' social evaluations of dying patients (Glaser & Strauss, 1964) and physicians' attitudes toward the elderly (Coe & Brehm, 1972, p. 103) have been found to influence the frequency and quality of patient care.

The concept of variability has been described by several authors (Kovner, 1966, p. 74; Perrow, 1967, p. 197; Woodward, 1970, pp. 20-28) as an important technological characteristic. Because human service organizations are dealing with people there is likely to be a high degree of variability between clients. For example, in his study of hospital nursing units,Kovner (1966, p. 78) noted differences between nursing units in terms of the variety of patients admitted to each unit. Closely linked to the concept of variability is the notion of exceptional cases. Accordingly, there are likely to be differences

between patients during times of illness in the degree of criticality of their health problems and the frequency with which emergency situations may occur. Because this type of variability in clients may be a continual source of uncertainty,it has been suggested that human service organizations attempt to control the variety of clients through screening procedures, "stereo-typing", and, in some instances, specializing their services so that they are limited to a restricted group of clientele (Hasenfeld & English, 1974, p. 14). This latter point is illustrated for hospitals by the manner in which specialized patient groups, for example, renal dialysis patients or cardiac patients, are grouped geographically within separate nursing units.

Clients attending human service organizations, and in particular entering hospitals,are presenting more and more complex problems. Not only do patients come to hospitals to be cared for and cured from patho-physiological problems, but there is an increasing number of persons with a wide range of socio-psychological problems in hospitals (Hasenfeld & English, 1974, p. 17). The complexity of problems is increased by many persons presenting multiple rather than one single health problem. This is due in part to past success of the health care services in handling some "known" health problems and also to an increasing number of elderly persons entering the hospital who have a greater risk of developing secondary complications (Rambout, 1975, p. 16). Furthermore, due to larger social phenomena,such as ecological problems, the complexity of patients' health problems are increasing. Also, greater public expectations in terms of the range of services which should be provided by hospitals since the introduction of Medicare in 1968 , increases the complexity factor. These types of

complexity, according to Hasenfeld and English (1974, p. 14) tend to enlarge the uncertainty factor for organizations since there is limited and sometimes conflicting knowledge available for deciding which techniques might be effective in resolving such problems. As a result human service organizations tend to develop sets of working assumptions about their clients which become reified in their technology.

Techniques. Operations for transforming raw materials at the workflow level were described by Hickson et al. (1968,pp.378-381) as the equipping and structuring of activities in the production and distribution of output. This concept of technology is not easily translated to human service organizations since the central core of activities focusses in the large part upon staff-client relations. Although mechanization and some automation has been introduced in hospitals, this has generally been for administration purposes (Tinker, 1973) or due to increases in sophistication in medical technology, for example, cardiac monitoring and haemodialysis (Goshen, 1972).

Perrow (1967, p. 196) described techniques from a cognitive perspective in terms of the degree to which workers' search behaviour for the appropriate technique is analyzable and the specific mechanisms used by the organization to handle exceptional cases. This definition allows for a more comprehensive way of thinking for staff-client relationships. Perrow pointed out that organizations may standardize procedures, for example, by cutting down on search processes when clients present complex problems which are not well-understood. The techniques used in these instances will be known to be "second best", that is, not as efficient or effective as they might be. For example,

a psychiatric hospital might emphasize custodial rather than rehabilitation approaches since little is known about the rehabilitation process.

Nursing techniques for transforming raw materials are the actions involved in the nursing process, in essence, planning, implementing and evaluating care (Kron, 1971, p. 12). Three distinct aspects of nursing work in the organizational context have been described: those concerned with cure processes; those concerned with care processes; and those involving coordination of patient care (Mauksch, 1966, pp. 109-137). The activities involved in care and cure processes, defined by Wooldridge et al. (1968, p. 8) as comprising nursing practices, basically constitute the techniques used by nurses to bring about health changes in patients. Cure processes are primarily related to the diagnosis and medical treatment of patients. Although the physician is responsible for issuing directives for patient cure processes, a significant proportion of nurses' time is spent processing and implementing and following through on these orders. This area of nursing practice includes such work as performing technical procedures, the use of special equipment and the administration of drugs. According to Wooldridge et al. (1968, p. 9), cure activities have the goal of bringing about a more or less permanent change or correction in persons' behaviour, and mainly concerned with techniques for meeting patients patho-physiological needs. An exception in this regard, relates to health education functions of the nurse, since these may be aimed to cure, but do not necessarily involve patho-physiological needs of patients. Cure practices are controlled by medical guidelines and usually the specific actions of the nurse in relation to the cure techniques she uses are spelled out in considerable

detail by the physician (Wooldridge, Skipper & Leonard, 1968, p. 19). Care processes are less easily discernable than cure processes, in that they cover a wider range of functions and circumstances. The aspect of nursing practice concerned with care has been described as the independent (from the physician) functions of the nurse and consists primarily of meeting patients' socio-psychological needs derived from their illness or hospitalization (Mauksch, 1966, pp. 112-120), and providing "comfort" for patients (Stinson, 1969, p. 324). Wooldridge et al. (1968, p. 11) indicated that such needs are situationally-derived rather than pathologically derived, hence the goal of such activities are likely to be to prevent or correct an undesirable effect in the short term, without attempting to modify permanently the source of the problem. However, current approaches to health care suggest that short term goals are inadequate and attempts must be made to identify and correct the underlying problems (Lalonde, 1974). In long-term illnesses, situationally-derived needs of patients are likely to persist over a longer period and in these circumstances goals do tend to change to an emphasis upon increasing the patient's ability, where possible, to meet these needs for himself. Guidelines for care practices are specified and controlled by the nurses themselves. However, they only direct the individual nurse's actions in a general sense, for example, by indicating that she should be helpful and treat each patient as a unique individual. In the practical situation each nurse is left to decide, based upon her own ideas about human behaviour, which techniques to use and how artistic she might be in a given situation (Wooldridge et al., 1968, pp. 12-20). This type of ambiguity presents a dilemma in attempting to analyze the technology of nursing organizations,

since it is possible that nurses, on the basis of their socialization to perceive each patient as an unique individual, might also perceive their work as highly variable and non-routine, which might or might not be the actual case (Scott, 1966, p. 43).

There is, however, a dearth of clear-cut knowledge which is unique to nursing (Jacox, 1974, Stinson, 1969, p. 329) due in part to the fact that independent nursing functions have not been clearly delineated. Further, nursing knowledge in the areas of cure techniques depends primarily upon medical knowledge and technology; for care techniques nursing knowledge is limited somewhat by the knowledge of the physical sciences, but more heavily limited by the lack of understanding of socio-psychological phenomena.

There is some evidence to suggest that there is a trend to systematically increase nursing knowledge in relation to patients' characteristics and the cause and effect relationships of nursing techniques used. This is demonstrated by the increase in clinical nursing research studies. For example, Cornell et al. (1973) compared techniques for the rehabilitation of spinal cord injury patients, and McCorkle (1974) investigated the effects of touch on seriously ill patients.

Task Interdependence. Because human service organizations are being presented with increasingly complex problems needing a wider range of expertise, a greater number and variety of professionals are being employed to cope with the uncertainty factor (Hasenfeld & English, 1974, p. 17). At the workflow level in nursing units of hospitals this is apparent by the increasing range of health care workers becoming directly involved in

patient care. In nursing units, then, it follows that task interdependence (Hickson, 1968, p. 283) might be relatively high and the ability to order work in programmed sequences will be relatively low. Because nursing personnel are continually present on the nursing unit, twenty-four hours a day, they deputize, to some extent, for other members of the health team in their absence. In addition, because of their continual presence and overview of all aspects of patient care, the day to day coordination of patient care and transmission of communication back and forth between patients, physicians, and other workers, constitutes a large proportion of nurses' work. This was referred to by Mauksch (1966, p. 126-136) as coordination of care and cure practices. Perrow (1967, p. 198) indicated that the type of coordination mechanisms employed varies as a function of the degree of routineness of the task, where work is perceived as routine, coordination is by planning and programming; where work is non-routine, coordination is more likely to be by feedback. For nurses the feedback may come from other nurses, other hospital workers and/or the patients themselves. It is also suggested that in nursing units the type of coordination mechanisms used might also vary as a function of the number and variety health care workers involved in providing patient care.

Some Structural Dimensions of Hospital Nursing Organizations

Some of the problems facing nurses in relation to what work they perform and how they perform it stem from the dual authority structure within the hospital (Malone, 1964). On one side, as a salaried employee, the nurse has a position within the formal bureaucratic structure and is responsible through this framework to administration. On the other side, she is answerable to the physician

because of his professional knowledge which comes from his superior clinical knowledge (Etzioni, 1964, pp. 87-89). It can also be argued there is a triple authority structure for nurses when the value system of the professional nursing organizations is included.

The division of a nursing organization within a hospital into sub-units is directly linked to the degree of specialization among physicians (Strauss, 1966, pp. 60-108). In most general acute hospitals a particular physician's patients are usually admitted to the same geographic unit, and the work performed by the nurses allocated to each unit tends to reflect the distinctive characteristics of the medical speciality; for example, psychiatric units, paediatrics units, obstetrical units and so on.

Each nursing unit has its own hierarchy of nurses with leadership positions of head nurse, assistant head nurse and/or team leaders. In addition, there is a variety of nurses with varying levels of education involved in providing patient care such as graduate nurses (usually registered nurses) registered psychiatric nurses, nursing aides, nursing orderlies and nursing assistants. In general, these three latter groups perform simple routine procedures and have tended to take over some basic bedside care from graduate nurses (Katan, 1974, p. 645).

Technological Differences Between Nursing Organizations

On the basis of the author's experiences, discussions with nursing administrators, and the apparent increasing specialization in medicine, it is suspected that there are differences in the kinds of work nurses do at the workflow level in various types of nursing units. However, there appears to have been very little research aimed

specifically at describing nursing technology or at identifying systematic similarities or differences between nursing sub-units.

The work of Kovner (1966) is an exception. As reported earlier, he described three categories of nursing sub-units in relation to their technological complexity: intensive care units and neuro-surgical units were described as being characterized by high complexity; medical teaching and rehabilitation and acute psychiatry by intermediate complexity; and rooming-in, medical-surgical and rehabilitation by relatively low complexity.

Coser (1958) compared differences between a medical and a surgical ward in a research and teaching hospital. The primary objective of this investigation was to compare social structure and role behaviour of medical and nursing personnel in the two wards. Coser attributed the differences she observed between the medical and surgical units, partially to the different task orientations in each work situation.

Other researchers have attempted to describe unique characteristics of individual types of nursing units through participant observation studies. Strauss (1975, pp. 81-97), for example, described the nursing organization of a psychiatric unit in terms of the nurses' perceptions of themselves as managerial and therapeutic agents and their ability to perform beneficial acts for patients. Benner (1975, pp. 106-128) described the mystique of the intensive care unit in relation to its awe-inspiring, machine-dominated, life-saving, crisis intervention and highly technical orientation. The characteristic interactions between nurse, patient and family on a paediatric unit are discussed in detail by Kramer (1975, pp. 133-143).

There have been some beginning attempts to compare personal attributes of nurses working in various types of sub-units, for example, psychiatric, medical and surgical units (Lentz & Michaels, 1965). The results of these investigations suggested that nursing specialities may call for specific personality types to cope with the particular work demands of the various sub-units. However, these studies are limited in their applicability to the investigation of differences in organizational technology, since the unit of analysis is the individual nurse rather than the nursing unit as a whole.

Although the research aimed at describing and investigating differences between nursing sub-unit technologies has been somewhat sparce, the studies to date tend to support the notion that the work of the various types of sub-units is in fact different. The lack of research in this area provides further justification for the need for investigation into these aspects.

CHAPTER III

METHODOLOGY

Statement of Problem

The main purpose of this investigation was to empirically investigate and describe the nursing tasks performed on selected and varied types of nursing sub-units within hospitals. Specifically, it was an attempt to measure three hypothesized dimensions of technology: the nature of raw materials; the nature of techniques to alter raw materials; and the type of task interdependence. Subsidiary purposes included 1) examining the extent to which nursing sub-units could be differentiated in terms of technological tasks and 2) partially examining the construct validity of the technological measures.

Operationalization of the Concept of Technology

Previous empirical research, for example, the work of Kovner (1966) and Lynch (1974) suggests that the operationalization of a concept of technology must be tailored to the specific type of organization and a particular level of analysis. For this investigation the following operational definitions were used.

The Nature of Raw Materials

For nursing sub-units within hospitals, the patients admitted to each nursing unit were considered equivalent to Perrow's concept (1967, p. 195) of raw materials. Instability in raw materials was operationalized in terms of the number of patients requiring frequent

nursing observation and the frequency of patient emergencies occurring. Indicators of the variability in patients were the variety of health problems, and various age groups of persons presenting themselves for care. The degree to which patients' health problems are or are not understood, was seen in terms of the complexity and multiplicity of problems patients present to nurses,and manifestations of these factors by the length of health history required and the predictability of their length of stay.

The Nature of the Techniques Used to Transform Raw Materials

Techniques used to transform raw materials were operationalized as the nursing techniques involved in providing care to patients. The analyzability/unanalyzability of search behaviour and processes for handling exceptional cases were defined in terms of the types of skills involved and the extent to which operations were not programmed. Three types of skills were identified: technical; judgmental; and communicative. Indicators of the extent to which operations were not programmed were the degree to which 1) technical equipment was not used, 2) goals were not specified, 3) nursing care was dissimilar for most patients, 4) nursing tasks involved analyzing complex problems and 5) were directed towards patients' socio-psychological needs. Further, the degree of repetitiveness in decision making, the speed of task obsolescence, the difficulty of learning a nursing specialty, and pressures of time and stress, were all considered indicators of the extent of lack of programming of nursing operations.

The Type of Task Interdependence

Task interdependence was seen in relation to the nursing

sub-unit's requirement for nurses within the unit to work together as a team and the dependence of the nursing sub-unit upon others to carry out its required tasks. Within the nursing sub-unit, task interdependence was operationalized in terms of the degree to which the nurses relied upon assistance from other nurses within the same unit to complete their work. External to the nursing sub-unit, task interdependence was viewed in relation to the extent to which nursing tasks relied upon feedback from patients, communication with physicians, services from other departments in the hospital, and other nursing sub-units.

Unit of Analysis

Since it was suspected that differences in technology would be most manifest at the workflow level within hospitals where specialization has taken place, the unit of analysis for this investigation was the nursing sub-unit. A nursing unit was defined as a geographic in-patient area of a hospital having an assigned number of beds, its own regular complement of nursing staff with a shared goal or goals, a formal hierarchical structure and arrangements for getting work done; that is, it could be considered a bounded administrative and social unit. A nursing sub-unit was seen as comprising a varying mix of levels of nursing staff which could include head nurses, assistant head nurses, team leaders, registered nurses, registered psychiatric nurses, certified nursing aides, nursing orderlies and nursing assistants.

Types of Nursing Units

The types of nursing units were selected using two main

criteria. First, on the basis of the literature and the author's experiences, sub-units were selected whose technologies were assumed to be relatively distinct; and second, the nursing specialties had to be numerous enough so as to generate a large enough sample.

The units selected were:

1) paediatric units (PAEDS):comprising of children under the age of sixteen years with general medical-surgical disorders;

2) obstetrical units (OBS): comprising of both anti- and post-partum patients but not including delivery room and nurseries;

3) rehabilitation units (REHAB): comprising of adult patients with primarily physical disabilities requiring an active rehabilitation program;

4) intensive care units (ICU): comprising of patients with a variety of diagnoses admitted for "general" intensive care, and/or comprising of patients with one specific disease requiring "specialized" care;

5) auxiliary care units (AUX): comprising of patients requiring long-term care, including the chronically disabled and the aged;

6) psychiatric units (PSYCH): comprising of adult patients requiring active psychiatric treatment;

7) surgical units (SURG): comprising of adult patients admitted for general surgical procedures, but not for specialized surgery such as cardiac surgery, neuro-surgery, orthopaedic, or ear, nose, throat and eye surgery.

Population

The proper sampling procedure was to obtain a sufficiently large random sample of nursing sub-units to assure generalizability of findings and obtain statistical power of no less than .80 for small effect sizes. Low power of a statistical test indicates a high probability of rejecting the effect,when the effect exists (Cohen,

1969, pp. 1-16). Effect size in this instance relates to the degree to which the technological differences actually exist between units. A small difference or effect size would not generally be perceivable by the individual nurse. A large difference would be so obvious that the reason for the research might be questionable. Medium difference or effect size is in between the two extremes (Cohen, 1969, p. 13). It was estimated that if medium technological differences could be assumed, then a sample size of 32 nursing sub-units of each of the 7 types would be required to obtain power of .80 with a significance level of .05 when using the F test for analysis of variance. When only small differences are assumed then for approximately the same power and with the same level of significance, 196 nursing sub-units of each of the 7 types would be required (Cohen, 1969, p. 315). Such large sample sizes were unattainable for this research project.

The population then was restricted to nursing sub-units in selected hospitals within Edmonton and district. Four out of five possible acute care hospitals in Edmonton with more than 350 beds were included, the fifth hospital being unable to participate because of an on-going strike of non-medical workers. Two auxiliary hospitals, one active rehabilitation, and one psychiatric hospital were selected on the basis of willingness of the nursing department to participate. The total population of each type of unit in each hospital was procured with the exception of surgical units from one acute care hospital.[1] The actual nursing sub-units participating, according to type of

[1]These surgical units comprised of approximately 200 beds, and were excluded for reasons not related to the investigation itself.

nursing specialty and type of hospital, are shown in Figure 2.

Type of Nursing Sub-Unit	Type of Hospital								Total/ Unit
	Acute 1	Acute 2	Acute 3	Acute 4	Psych 1	Rehab 1	Aux 1	Aux 2	
PAEDS	6	4	3	1					14
OBS	4	2	1	1					8
REHAB		1				9			10
ICU	2	4		1					7
AUX		1	1				4	4	10
PSYCH	1	2		2	3				8
SURG	6	6	2						14
Total/ Hospital	19	20	7	5	3	9	4	4	71

Figure 2. Nursing Sub-units Participating in the Study

The size of the nursing sub-units ranged from 5 to 54 beds (mean 32 beds), and from 8 to 38 full-time employees (mean 18 employees).

Measurement of Technology

Measures of technology were obtained through the development of a questionnaire which reflected individual nurses' perceptions of the work of the sub-unit. This perceptual approach assumes that reliable and valid measures of nursing sub-unit technology can be obtained by aggregating the perceptions of responses of the nurses within each sub-unit. This method is appropriate given that Perrow's cognitive approach to technology has been used consistently in organizational research. The nurses participating in the study were

selected randomly from lists for each sub-unit of all full-time nursing staff who had worked on their particular unit for at least three months. A total of five nurses were chosen from each unit, proportional to the ratio of graduate nurses to "other category" of nurses on each unit. Included in the "other category" of nurses were, registered psychiatric nurses, certified nursing aides, nursing orderlies and nursing assistants. The sample consisted of three graduate nurses and two "other" nurses in the acute care hospitals, and two graduates and three "other" nurses in the other hospitals. In ten units, only graduate nurses were employed. Seven of these were intensive care units and three surgical units. The rationale behind the sampling procedure was that the composition of nurses within each sub-unit in terms of level of education and other personal variables would probably vary, therefore, random selection gave some assurance than an aggregation of the individual nurses' perceptions of sub-unit technology would adequately represent the "true" technology of the nursing unit as a whole.

Pilot Study[1]

An initial questionnaire was designed to measure or operationalize the three dimensions of technology: the nature of raw materials; the nature of techniques to alter materials;and the type of task interdependence. A pilot study was conducted for the purposes of 1) testing

[1]This pilot study was undertaken as a term project in a course in Statistics and Research Methods, HSA 531, under the direction of Dr. C.B. Hazlett. I greatly acknowledge the help of Dr. Hazlett and colleague M. Makowsky.

the wording and presentation of items, 2) eliminating items and thereby reduce the length of the questionnaire while keeping its discriminating power, and 3) assessing the construct validity of the measure of technology by comparing questionnaire responses with data obtained by another independent method of measurement (an analysis of the written patient care plans).

The pretest questionnaire (shown in Appendix A) comprised of 58 items, 9 of which were modifications from Kovner's instrument (1966, pp. 167-178), and 13 from Lynch's questionnaire (1974, pp. 354-355). The remaining 36 questions were constructed specifically for this current investigation.

Data for the pilot study were obtained from two psychiatric units and two obstetrical/gynaecological units in a large teaching hospital in Edmonton. The unit of analysis was the individual nurse, with a total of 60 nurses participating. The data were analyzed using orthogonal factor analysis techniques with varimax rotation. The analysis resulted in three orthogonal factors which were labelled, uncertainty of task information, variability in patients, and task independence from non-medical departments. Evidence of some degree of construct validity of the questionnaire was seen in the similarity in factor structure obtained by the two independent methods of measurements. The factor solutions are shown in Appendix A. Through application of analysis of variance procedures, and as anticipated a priori, the psychiatric nurses were found to have significantly ($\alpha = .05$) greater uncertainty in task information and variability in patients than obstetrical/gynaecological nurses. This pretest study, however, was limited by the fact that the unit of analysis was the

individual nurses not the nursing sub-unit, and only two types of nursing units were included.

Research Instrument

The specific questionnaire used in this investigation (see Appendix B) was based upon a wide range of content in an attempt to adequately cover not only measurement of nursing tasks but also the body of concepts pertaining to technology of nursing sub-units. In addition, all items were designed to solicite nurses' opinions concerning task behaviour and not job attitudes. Items were worded to obtain the nurses' views upon the tasks of the nursing sub-unit as a whole, as opposed to only the tasks individual nurses performed.

On the basis of the results of the pretest the original questionnaire was refined in several ways. First, in attempting to comprehensively measure the three dimensions of technology and without jeopardizing this objective, 34 items were selected from the 58. These included items with high factor loadings in the pretest, and also a few items with low factor loadings judged essential to the concept of technology. Eight of these items were adaptations from Kovner's questionnaire (1966, pp. 167-178) and 8 were modifications of Lynch's questions (1974, pp. 354-355). The remaining 18 items had been designed specifically for this research. Items 1 to 6, 33 and 34, were intended to measure the nature of raw materials. Items 7 to 24 and 32 related to the nature of nursing techniques, and items 25 to 31 related to task interdependence. Within each of the groups the items were randomly ordered to avoid a predetermined response set. Second, the pretest questionnaire was modified to standardize responses for almost all questions to a 5 point scale. For each question the

respondent was asked to estimate a percentage. These percentages related to patients, nursing tasks, or time. Although the 5 point response scale was not equidistant in terms of actual percentages, the points were considered conceptually equidistant, and for analysis purposes were given numerical values ranging from 1 to 5. The rationale for this procedure was that from a practical standpoint it was considered equally important for a nurses to answer 0-5% as 6-25%, 26-50%, 51-75%, and 76-100%. The 0-5% category was an attempt to provide an opportunity for the nurses to respond in terms of extreme, rare, or occasional situations, which was desirable from the theoretical viewpoint. For example, for psychiatric units in relation to item 12, it was suspected that there would rarely be patients on these units requiring intravenous infusions. An equidistant 5 point scale with a lower category of 0-20% would not have given the opportunity for as accurate a response as the 0-5% category, and the rare situation could not have been identified.

Data Collection

At each of the eight hospitals used in the study the nursing administrator was interviewed and the nature of the investigation described to middlemanagement nursing personnel. The questionnaires were given to supervisors or head nurses to distribute to the five randomly selected nurses from each sub-unit. A total of 355 questionnaires were given out with a response rate of 95.5%. The criterion established a priori was that there should be at least two responses from an individual nursing sub-unit for it to qualify for the study. The purpose for this criterion was that two responses or more (as

opposed to one response), provided greater assurance that the responses would accurately represent the opinions of the nursing sub-unit as a whole. All nursing units returned at least two questionnaires. There was one unit where there were only two responses, one unit where there were three responses, 11 units with four responses. All other 58 units had five responses. The total number of nursing sub-units remained at 71.

Data Analysis Procedures

The arithmetic mean of within unit nurses' responses was defined as the nursing sub-unit response for each item. Since the unit of analysis was the nursing sub-unit, all the analyses were based on these meaned unit responses.

Factor analysis was used as a descriptive technique to summarize the data and to provide a basis for interpretation (Holzinger & Harman, 1941, p. 23). The main purpose in the analysis was to provide a basis for comparing the extent to which the factor solutions obtained would match the hypothesized technological dimensions. Both orthogonal and oblique solutions were obtained. A varimax rotation usually has the advantage of 1) obtaining simple structure, and 2) leading to factorial invariant solutions i.e. similar solutions would be obtained in repeated studies (Harman, 1964, p. 347). For the oblique analysis, Promax rotation was applied because this technique is reported to be a relatively efficient method for rotation to oblique simple structure since it builds upon the orthogonal-varimax solution (Hendrickson & White, 1964, pp. 65-70), yet allows factors to correlate. This latter feature was desirable in this investigation

since it was not known to what degree constructs of technology of nursing units might be interrelated.

Once the most useful factorial description of the data, in relation to the theoretical framework and inferential capabilities was obtained, factor scores were calculated ($\mu = 25$, $\sigma^2 = 25$) for each nursing sub-unit, and F tests based on analysis of variance were performed to examine the significance of differences between nursing sub-units. The use of this type of inferential statistic necessitated assumptions about the data in relation to the normality of the distribution of responses, homogeneity of variance and a subsequent degree of factorial invariance (Winer, 1971, pp. 149-167).

Newman-Keuls method for multiple comparisons were used if nursing units were significantly different on any factor score. According to Winer (1971, p. 216) this method is appropriate for testing differences when sample sizes are unequal but not markedly different.

Q technique (Cattell, 1969, pp. 90-91) was used to explore the extent to which the nursing sub-units would cluster together because of underlying similarities. This analysis is based upon the transposed data matrix and is suggested as an ideal method (Cattell, 1969, pp. 90-100) for finding similar types of nursing sub-units, if they exist, in relation to the technological dimensions. The transposed data matrix comprised of 71 variables (units) and 34 subjects (items). In such circumstances, linear dependencies may exist thus restricting generalizability of findings (Cattell, 1969, pp. 98-102).

Validity of the Measure

The reliability and validity of measures of technology developed in research in human service organizations, have not been reported in detail. Lynch (1974, p. 340) pointed out that, generally speaking, researchers have been eager to move on to the process of hypothesis-testing without giving adequate attention to evaluating the reliability and validity of their technological measures.

The reliability of a measure refers to its internal consistency, and the interest is upon the degree to which the same responses or results would be obtained over repeated measures, either in the same time frame by parallel forms, or on a different occasion (Crohnbach, 1970, pp. 173-179). The validity of a measure, of which there are several types, relates to the extent to which the instrument measures what it has been designed to measure (Fox, 1970, p. 244). Of the two features, it is more important to evaluate the validity of a measure than reliability, since if an instrument is shown to be valid, it will also by necessity meet criteria for reliability.

Three major categories of validity have been defined: content; criterion-oriented; and construct (Crohnbach & Meehl, 1955, p. 281). Content validity refers to the degree to which the content of the measure is representative of all possible content (Crohnbach & Meehl, 1955, p. 282). For this investigation, the universe of content for a measure of technology of nursing sub-units was not known. Criterion-oriented validity is characterized by prediction to an outside criterion, that is, by checking the instrument against some outcome or other measure of technology (Crohnbach & Meehl, 1955, p. 282). In this particular case no criterion measure was readily available.

Since there was no objective criterion available to measure sub-unit nursing tasks, the degree of construct validity (Crohnbach & Meehl, 1955, p. 282) of the measures was partially examined. A construct is a postulated attribute, here, a hypothesized technological dimension, which is assumed to be reflected in the measure. The extent to which the hypothesized dimensions are reflected in empirical findings can provide information regarding the degree of construct validity possessed by the measure.

The examination of the construct validity of the measure, however, is limited, and the information provided is suggestive rather than evidential because for a measure to be described as possessing construct validity it must demonstrate both convergence and discriminability. This means that different measures of the same construct should be shown to correlate higher with themselves than measures of other constructs using the same method (Campbell & Fiske, 1959, p. 81). In this research the technological dimensions were measured by only one method, therefore, comprehensive analysis was not possible.

Factor analysis, however, can be useful in examining construct validity because questionnaire items measuring the same hypothesized dimensions will tend to correlate and show up in the factor solutions as loadings on the same factor. Furthermore, the proportion of variance in responses explained by the factors can be considered a numerical indicator of construct validity. Also, if differences between nursing sub-units in terms of technological factors are suspected a priori and these differences are confirmed in results, then this is suggestive of construct validity of the measure (Crohnbach & Meehl, 1955, pp. 287-289). Both the analysis of variance and the use of

technique Q analysis enabled some comment upon the construct validity of the technological measure from this perspective.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

This chapter is divided into three sections. First, the data from the questionnaire are analyzed 1) in relation to the factor analysis procedures, 2) using the analysis of variance tests for finding differences between nursing sub-units, and 3) using the Q technique for finding the categories of nursing units. Second, the results of the analyses are discussed in terms of the organizational theory and prior empirical research. Third, the construct validity of the measure of technology is partially assessed.

Analysis of the Data

Factor Analysis

All the unit scores for the 34 variables from the questionnaire (of Appendix B) were meaned and initially analyzed for an orthogonal principal axis factor solution. Eight factors were obtained with eigenvalues greater than one, explaining 75% of the variance in unit responses.

Factor analysis was repeated reducing the number of factors to 5, 4, 3, and 2, in order to find the most interpretable solution in terms of the conceptual framework, while still explaining a reasonable proportion of variance in unit responses. The most satisfactory result in terms of number of factors was the three factor orthogonal solution using varimax rotation. Six items (6,7,9,28,29 and 34) were eliminated

because they did not load highly on any factor, and were not judged to be essential to the technological concept. The three factor orthogonal analysis with varimax rotation was repeated (on the 28 items) resulting in the factor solution shown in Table I. The three factors together accounted for 61% of the variance in unit responses. Of this 61%, 26% of the variance was attributable to the first factor, 23% to the second factor and 12% to the third factor.

In order to convey the essence of the three factors, each one is described in turn, along with an analysis and listing of items loading .50 or greater. Care must be taken, however, not to interprete only high loadings as a measure of the factor or even as a full reflection of the factor, since all items, whether low or high loadings contribute to the underlying essence of the factor.

Factor I. The aspects of nursing unit technology inherent in Factor I related primarily to the degree to which characteristics of patients are not understood, to the extent that they present complex problems (item 5), multiple problems (item 3), and a long health history is required (item 4). Search behaviours appear unanalyzable, to the extent that the work involves the analysis of complex problems (item 17), relies upon intuition as opposed to set procedures (item 20), techniques out-date quickly (item 23), and the specialty is difficult to learn (item 24). The skills involved are 1) communicative (item 32), and 2) judgement, in relation to how much discretion the nurses have (item 11),and how often they make decisions independent of the physicians (item 13). The amount to which the work is seen as contributing to the recovery of patients (item 16),and high stress is involved (item 14), are also important. The dependence of the nurses'

TABLE I

Factor Analysis - Orthogonal Solution Varimax Rotation

Item Number	Item Content	Communalities	Factors I	Factors II	Factors III
3	Pt. not understood	0.405	0.569[a]	-0.083	-0.271
4	Pt. not understood	0.592	0.738	0.183	0.122
5	Pt. not understood (Lynch[b])	0.729	0.749	-0.123	0.391
11	Skill judgement	0.354	0.574	0.030	-0.154
13	Skill judgement	0.344	0.570	0.025	-0.134
16	Tech. helpful to pt. (Kovner)	0.407	0.630	0.095	0.031
17	Tech. complex problems (Lynch)	0.822	0.788	0.193	0.405
20	Tech. intuition (Kovner)	0.704	0.819	-0.129	0.126
23	Tech. out-date quickly	0.409	0.555	0.237	0.214
24	Tech. difficult to learn (Kovner)	0.736	0.770	0.338	0.173
26	Feedback pt. condition	0.574	0.646	0.285	0.275
27	Nurse team work (Lynch)	0.552	0.714	0.068	-0.193
32	Skill communication (Kovner)	0.421	0.523	-0.310	0.226
14	Work stress	0.689	0.548	0.597	0.179
1	Pt. instability (Kovner)	0.581	0.463	0.603	-0.052
8	Skill technical (Kovner)	0.714	0.028	0.844	-0.033
10	Tech. equipment	0.836	0.159	0.892	-0.121
12	Tech. equipment	0.868	0.118	0.919	-0.102
15	Work time pressure	0.761	0.393	0.777	-0.048
18	Tech. goals for care plans	0.702	0.249	-0.738	0.309
19	Tech. socio-psychological	0.765	0.469	-0.660	0.332
30	Feedback physician	0.364	-0.069	0.578	0.160
31	Feedback physician (Kovner)	0.673	-0.092	0.713	0.395
33	Pt. emergencies (Kovner)	0.725	0.332	0.759	0.198
2	Pt. variability (Lynch)	0.472	-0.273	0.008	0.631
21	Tech. variability (Lynch)	0.714	0.064	-0.072	0.839
22	Tech. non-repetitive (Lynch)	0.761	0.196	0.110	0.843
25	Feedback pt. planning	0.455	0.412	-0.128	0.518
		17.127	7.274	6.579	3.274

Note. The items have been re-ordered from the original (Appendix B) for ease of viewing loadings of .50 and greater on each factor.

[a] loadings of .50 and greater are underlined

[b] source of modified items

tasks on feedback from patients (item 26) and the need for the nurses to work as a team (item 27) are of significance. This factor was labelled "uncertainty". Items with loadings of .50 or greater are as follows:

Item

3. Some patients are admitted to hospital because they have one main health problem, others becuae they have several inter-related health problems. What percentage of the patients on your unit has multiple health problems?

4. For some patients more than others, it is important to know complete details of their previous health history. For how many of the patients on your unit is it critical that the nurses know a detailed history from birth to present time?

5. What percentage of the patients on your unit has complex problems that are not well understood?

11. When there is more than one method available for giving nursing care, what percentage of the time are you free to choose the method you think best?

13. How many of the decisions made by nursing staff relating to direct patient care are made independent of doctors orders?

16. What percentage of the time does improvement in patients' conditions really have to depend upon the skillful work and initiative of nursing personnel?

17. How much of your work requires the analysis of complex problems?

20. What percentage of the nursing care given relies upon nurses' intuition rather than on set procedures or routines?

23. What percentage of the present nursing care techniques used on your unit become quickly outdated?

24. What percentage of new nurses starting work on your unit would find the nursing care specialty difficult to learn?

26. How much of your work changes in direct response to change in patients' condition or mood?

27. What percentage of the time are you highly dependent upon other nurses in your unit for help and/or are they dependent upon your help?

32. Relative to other nursing skills (such as technical or decision-making), how important is it that you have effective communication skills?

14. Working on some units produces a higher stress environment for nurses. How much of the time would you say there is a high stress environment on your unit?

Factor II. Aspects of nursing unit technology described by Factor II primarily related to the degree of instability of patients in terms of the number of emergencies (item 33) and the frequency of nursing observation required (item 1). The characteristics of search behaviours included the use of technical skills (item 8), and technical equipment (item 10 and 12), and the extent to which work is not concerned with socio-psychological needs of patients (item 19), or the specification of individualized goals for patient care (item 18). High time pressure (item 15) and high stress (item 14) are also of interest. The degree of physician involvement in terms of numbers prescribing treatments for individual patients simultaneously (item 30) and frequency of communication with physicians (item 31) is of importance. This factor was labelled "instability". Items with loadings of .50 or greater are as follows:

Item

1. In your estimation, what percentage of patients on your unit needs nursing observation more often than once every half hour?

8. What percentage of the nurses' work involves performing technical procedures and special tests?

10. What percentage of patients require the use of technical equipment (i.e. suctions, cardiac monitors, respirators, etc.)?

12. How many of the patients on your unit on an average day require an intravenous infusion?

14. Working on some units produces a higher stress environment for nurses. How much of the time would you say there is a high stress environment on your unit?

15. On some units there is a greater pressure to give nursing care quickly because of patients' critical conditions. What percentage of the time is there a greater time pressure on your unit?

18. For how many of the patients are there written goals for individualized care in the Kardex (nursing care plan)?

19. What percentage of the nursing care on your unit is directed at meeting patients' sociopsychological needs (as opposed to physical needs)?

30. How many of the patients on your unit have more than one attending physician simultaneously prescribing care?

31. How frequently do the nurses on your unit have verbal or written communication with medical staff (attending physicians, consultants, medical students, etc.)?

33. Approximately how often do "emergencies" happen (i.e. when immediate nursing action must be taken in response to change in patients' conditions)?

Factor III. Aspects of nursing unit technology inherent in Factor III related to the variability in patients in terms of the degree to which they present dissimilar health problems (item 2). The characteristics of search behaviours of importance are, the extent to which nursing care is individualized (item 21), patients are included in planning care (item 25), and decisions are non-repetitive from one day to the next (item 22). This factor was labelled "variability". Items with loadings of .50 or greater are as follows:

Item

2. How many of the patients would you say have similar health problems (or diagnosis)? (reversed).

21. How many of the nursing care procedures are similar for most of the patients on your unit? (reversed).

22. What percentage of the decisions the nurses make during their work are repetitive from one day to the next? (reversed)

25. How many of the patients and/or the families are included in discussions when their nursing care is being planned?

An oblique solution for the three factors was also examined, however, primary factor and reference vector (pattern and structure) solutions were comparable with the orthogonal solution in Table I. Correlations among the factors were relatively low. Between Factors I and II, the correlation coefficient was .12, between Factors I and III, .12, and between II and III the coefficient was .04. This demonstrated that the factors were comparatively independent.

Sub-unit Differences

The results of the analysis of variance procedures to examine differences between the 7 types of units in relation to the three factors, uncertainty, instability and variability, are shown in Table 2. These results indicate that F tests for differences in variance of the factor scores between the 7 types of units were significant for all three factors at the .05 significance level.

Newman-Keuls multiple comparisons between ordered means were performed for the three factors and the details of these results are shown in Table 3. Differences between ordered means on each factor were considered significant at the .05 level of significance. Although the Newman-Keuls analysis placed sub-units in order for each factor, where differences between sub-units were not significant at .05 level of significance, for interpretation purposes they were considered equivalent.

For the uncertainty factor, the psychiatric units were ordered highest followed by the intensive care units, however, these two types of units were not different from each other in terms of uncertainty. The auxiliary units were lower in uncertainty than both psychiatric units and intensive care units. All these three types of

TABLE 2

Analysis of Variance on Factor Scores

Factor	Source	Sum Squares	Mean Square	DF	F	P
I. Uncertainty	Groups	1287.86	214.64	6	28.19	0.0*
	Error	487.33	7.61	64		
II. Instability	Groups	1625.11	270.85	6	115.65	0.0*
	Error	149.89	2.34	64	18.06	
III. Variability	Groups	1116.07	186.01	6	18.06	0.0*
	Error	659.02	10.30	64		

* Indicates significant at 0.05 level.

TABLE 3

Newman-Keuls Comparisons Between Ordered Means

Factor I Uncertainty			PSYCH	ICU	AUX	REHAB	PAEDS	SURG	OBS
			33.087	31.373	27.291	23.167	22.957	21.478	20.499
	OBS	20.499	12.588*	10.874*	6.793*	2.668	2.458	0.979	0.0
	SURG	21.478	11.609*	9.896*	5.814*	1.689	1.480	0.0	
	PAEDS	22.957	10.130*	8.416*	4.334*	0.210	0.0		
	REHAB	23.167	9.920*	8.207*	4.125*	0.0			
	AUX	27.291	5.796*	4.082*	0.0				
	ICU	31.373	1.714	0.0					
	PSYCH	33.087	0.0						
		R =	7	6	5	4	3	2	
	$q_{.95(r,64)}$ x M =		3.86	3.72	3.56	3.36	3.04	2.53	

M (Multiplier) = 0.89459

Factor II Instability			ICU	SURG	PAEDS	OBS	REHAB	PSYCH	AUX
		Means	35.730	28.556	25.837	23.796	21.464	21.320	18.776
	AUX	18.776	16.954*	9.780*	7.061*	5.020*	2.688*	2.544*	0.000
	PSYCH	21.320	14.410*	7.236*	4.517*	2.476*	0.144	0.000	
	REHAB	21.464	14.266*	7.092*	4.373*	2.332*	0.000		
	OBS	23.796	11.934*	4.760*	2.041*	0.000			
	PAEDS	25.837	9.893*	2.719*	0.000				
	SURG	28.556	7.174*	0.000					
	ICU	35.730	0.000						
		R =	7	6	5	4	3	2	
	$q_{.95(r,64)}$ x M =		2.14	2.06	1.98	1.86	1.69	1.40	

M (Multiplier) = 0.49613

Factor III Variability			PSYCH	PAEDS	SURG	REHAB	ICU	OBS	AUX
		Means	32.902	27.296	26.175	25.135	25.135	20.588	19.757
	AUX	19.757	13.145*	7.539*	6.418*	5.378*	1.606	0.831	0.000
	OBS	20.588	12.145*	6.707*	5.587*	4.547*	0.774	0.000	
	ICU	21.363	11.539*	5.933*	4.813*	3.772	0.000		
	REHAB	25.135	7.767*	2.161	1.040	0.000			
	SURG	26.175	6.727*	1.120	0.000				
	PAEDS	27.296	5.606*	0.000					
	PSYCH	32.902	0.000						
		R =	7	6	5	4	3	2	
	$q_{.95(r,64)}$ x M =		4.48	4.33	4.14	3.89	3.54	2.94	

M (Multiplier) = 1.04031

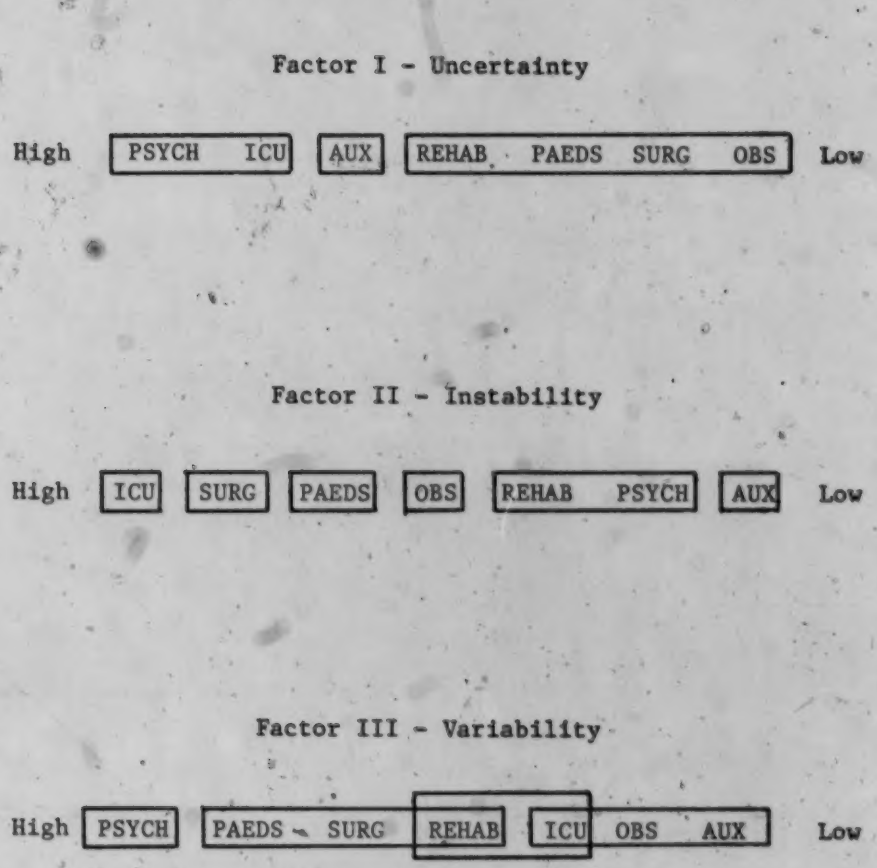
*Indicates significant at 0.05 level.

units were greater in uncertainty than rehabilitation, paediatric, surgical and obstetrical units. These latter four types of units were, however, not different from each other in terms of uncertainty. These results indicated that the types of nursing sub-units were basically divided into three groups in relation to uncertainty: psychiatric and intensive care units high; auxiliary units moderately high; and rehabilitation, paediatric, surgical and obstetrical units low in uncertainty. The ordering of the types of units is shown in Figure 3.

In relation to the instability factor, there was a greater number of significant differences between the types of nursing sub-units than for the uncertainty factor. Intensive care units were higher in instability than the other types of units. Surgical units were lower in instability than intensive care units, yet higher than the other types of units. Paediatric units were lower in instability than surgery and intensive care but with greater instability than obstetrical, rehabilitation, psychiatry and auxiliary units. Obstetrical units were different from all other types of units in terms of instability, however, they were ordered below intensive care, surgery and paediatric units, yet above rehabilitation, psychiatric and auxiliary units. Rehabilitation and psychiatric units ordered relatively low in instability, different from other types of units but not from each other. Auxiliary units were lower in instability than any of the other units. The ordering of the units in terms of instability is shown in Figure 3. Only rehabilitation and psychiatric units were not different from each other, hence, the results demonstrated six categories of units in terms of instability.

For the variability factor, there were fewer differences

Figure 3. Ordered Nursing Sub-units.



Note. Sub-units enclosed in the same boxes indicate that differences between the mean factor scores were not significant for the Newman-Keuls method at .05 level of significance.

between the sub-units than for instability. Psychiatric units ordered the highest and these units were higher in variability than all the other types of units. Paediatric, surgical, and rehabilitation units,were not different from each other in variability. Paediatrics and surgery were greater in variability than intensive care, obstetrical and auxiliary units. However, rehabilitation units and intensive care units were not different from each other. The ordering of the units in relation to the variability factor is illustrated in Figure 3. Basically, in terms of the variability factor the types of sub-units grouped themselves into three categories. Psychiatric units alone and relatively high in variability in one category. In a second category with moderate variability were paediatric, surgery and rehabilitation units. The third category with relatively low variability were intensive care, obstetrical and auxiliary units.

The results of this Newman-Keuls multiple comparisons of means for the three factors,indicated that the ordering of the types of units and the number of significant differences between units was different for each factor. A given type of unit may order highly on one technological factor, yet relatively low on another. For example, psychiatric units were highest in terms of uncertainty and variability, but relatively low in relation to instability. This finding was to be expected since psychiatric units are primarily concerned with individual patients' socio-psychological problems rather than their patho-physiological instability. Intensive care units were highest with psychiatric units, in relation to uncertainty, and significantly higher than other units in terms of instability, however, they ordered relatively low in terms of variability. This finding was also to be

anticipated since intensive care units tend to focus constantly upon emergencies and patients' patho-physiological crises. The ordering of the auxiliary units lowest in relation to instability and variability, yet relatively high in terms of uncertainty, was unexpected because this type of nursing specialty has traditionally been viewed as comparatively routine. The relatively high uncertainty in this type of unit would suggest that this is not the case. A possible explanation for this is the increasing trend to emphasize social-psychological aspects of health care to institutionalized chronically sick and aged persons. In addition, it is suspected that persons in auxiliary units, particularly the elderly, are increasingly presenting more complex problems in terms of secondary complications. The obstetrical units ordered relatively low in uncertainty and variability. This was to be anticipated since the care of post-partum patients is generally predictable. A higher ordering of obstetrical units in relation to instability suggested that these units are more concerned with patho-physiological crises than other units such as rehabilitation, psychiatry and auxiliary. Paediatric, rehabilitation and surgical units,were not ordered highest or lowest on any factor, and in general they were ordered relatively close together on all three factors.

Categories of Nursing Sub-units

The purpose of the preceding analysis was to identify the relative positions of types of nursing sub-units or specialties in terms of the three independent technological factors resulting from the factor analysis. In this section, the analysis is concerned with identifying categories of nursing sub-units in relation to their technology as a whole. The use of Q technique caused the units to

cluster together on the basis of similarities in responses to all items in the questionnaire, therefore, placement of units within specific categories was because of their similarities in relation to a composite of the three technological factors of uncertainty, instability and variability.

The transposed matrix was analyzed for both orthogonal and oblique solutions. Initially, an orthogonal principal axis solution was sought, to identify the number of types of nursing sub-units. Ten factors, or categories emerged with eigenvalues greater than one, accounting for 87% of the variance in nursing units. Orthogonal analysis was repeated, reducing the number of categories to find the most interpretable solution. This turned out to be a three category, orthogonal, quartimax rotation solution, which explained 66% of the variation in units. The orthogonal solution is shown in Table 4.

The first category accounted for 38% of the variance in nursing units. When loadings of .50 and greater were examined, the sub-units included in this category were identified as: 13 of the 14 paediatric units, 6 of the possible 7 obstetrical units; the total 10 rehabilitation units; all the 14 possible surgical units; and 3 of the possible 10 auxiliary units (2 of these last 3 loaded heavily on the second factor).

The second category explained 15% of the variance in nursing units and included 9 of the possible 10 auxiliary units and all the 8 possible psychiatric units.

Category III accounted for 13% of the variance in nursing units and comprised all the 7 intensive care units. In addition the one paediatric unit which did not load highly in category I was included,

TABLE 4

Q Technique- Orthogonal Solution Quartimax Rotation

Continued

Type of Sub-Unit	Communalities	Categories I	II	III	Type of Sub-Unit	Communalities	Categories I	II	III
PAEDS	0.654	0.800[a]	-0.053	0.102	SURG	0.733	0.610	-0.056	0.270
PAEDS	0.789	0.824	0.30	0.137	SURG	0.640	0.789	-0.092	0.097
PAEDS	0.741	0.852	-0.145	-0.048	SURG	0.757	0.633	-0.243	0.546
PAEDS	0.741	0.801	0.117	-0.293	SURG	0.700	0.635	-0.082	0.538
PAEDS	0.494	0.564	0.101	0.407	SURG	0.695	0.647	-0.069	0.522
PAEDS	0.512	0.271	0.318	0.581	SURG	0.651	0.681	-0.160	0.401
PAEDS	0.759	0.798	0.337	0.094	SURG	0.484	0.631	0.079	0.282
PAEDS	0.747	0.858	0.108	0.007	SURG	0.726	0.554	-0.429	0.485
PAEDS	0.617	0.733	0.074	0.272	SURG	0.659	0.609	-0.034	-0.065
PAEDS	0.776	0.848	0.231	0.062	SURG	0.727	0.843	0.016	0.130
PAEDS	0.732	0.848	0.065	-0.096	AUX	0.700	0.485	0.672	-0.112
PAEDS	0.621	0.524	0.392	0.440	AUX	0.809	0.462	0.771	-0.025
PAEDS	0.485	0.510	0.426	0.209	AUX	0.800	0.518	0.729	-0.004
PAEDS	0.789	0.855	0.091	0.221	AUX	0.675	0.437	0.669	-0.096
OBS	0.706	0.830	0.115	0.061	AUX	0.651	0.539	0.576	-0.171
OBS	0.553	0.727	-0.067	-0.142	AUX	0.721	0.445	0.715	-0.106
OBS	0.363	0.582	0.074	-0.136	AUX	0.779	0.232	0.849	0.065
OBS	0.617	0.729	-0.075	-0.282	AUX	0.653	0.480	0.649	-0.034
OBS	0.456	0.630	0.193	0.150	AUX	0.637	0.627	0.494	-0.020
OBS	0.559	0.742	0.075	0.051	AUX	0.645	0.371	0.705	0.103
OBS	0.394	0.400	0.231	0.425	PSYCH	0.581	0.262	0.715	-0.030
OBS	0.714	0.815	0.213	0.063	PSYCH	0.633	0.394	0.650	-0.236
REHAB	0.504	0.595	0.386	-0.033	PSYCH	0.621	0.481	0.593	-0.195
REHAB	0.610	0.522	0.483	-0.323	PSYCH	0.501	0.428	0.581	-0.056
REHAB	0.559	0.584	0.361	-01296	PSYCH	0.713	0.394	0.744	-0.065
REHAB	0.567	0.719	0.205	-0.093	PSYCH	0.737	0.363	0.778	0.004
REHAB	0.652	0.638	0.402	-0.239	PSYCH	0.623	0.454	0.564	-0.315
REHAB	0.799	0.795	0.326	-0.246	PSYCH	0.616	0.463	0.547	-0.321
REHAB	0.797	0.813	0.365	-0.054	ICU	0.525	0.119	-0.134	0.702
REHAB	0.672	0.681	0.455	-0.002	ICU	0.753	0.032	-0.294	0.816
REHAB	0.789	0.803	0.346	-0.156	ICU	0.705	0.176	-0.044	0.820
REHAB	0.543	0.674	0.286	-0.087	ICU	0.816	0.098	-0.075	0.895
SURG	0.687	0.800	-0.072	0.208	ICU	0.702	0.093	-0.126	0.823
SURG	0.674	0.793	-0.135	0.163	ICU	0.745	0.136	-0.203	0.830
SURG	0.788	0.761	-0.390	0.236	ICU	0.770	0.055	-0.072	0.873
SURG	0.594	0.751	-0.174	0.015					
						46.941	27.411	11.132	8.397

Note. The units and category loadings are shown in two groups for ease of presentation. The analysis was performed on the data from all 71 units together.

[a]Loadings of .5 and greater are underlined.

and three surgical units which had also loaded highly in category I.

These results of the orthogonal analysis demonstrated that the different types of nursing specialties clustered within the three categories as shown in Figure 4.

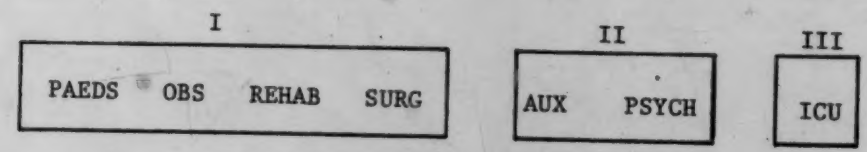


Figure 4. Categories of Nursing Sub-units Resulting from the Q Technique

As previously discussed, the underlying similarities which grouped the units into categories was a function of each sub-unit's technology- as a whole, rather than individual technological factors. The placement of intensive care units in a category almost alone was to be expected since these units are generally considered by nurses as somewhat mystical and awe-inspiring (Benner, 1975, p. 106). In intensive care units there is a high emphasis upon crises intervention. The emergencies are usually related to critical changes in patients' patho-physiological states. Compared with other units a greater amount of technical equipment and machines is involved in the nurses work, which is used to monitor and treat instabilities in patients' patho-physiologies. There are frequently many doctors in these units working alongside the nurses. In addition, patients admitted to intensive care units may have social-psychological symptoms accompanying the acuity of their physiological illness. These characteristics demand that the nurses provide not only technical assistance to the physician,

but also function somewhat independently from physicians to attempt to reduce the psycho-social stress of patients and families. However, by necessity the criticality of patients' patho-physiological conditions tends to take priority. These characteristics of intensive care units are suggestive of their uniqueness, and are supported by the high ordering of intensive care units on uncertainty and instability in the previous analysis. Intensive care units, as illustrated by their ordering relatively low on variability, have little variety in their patients or tasks since most patients are critically ill and all need intensive care. In support of this, Benner (1975, p. 106) pointed out that intensive care units emphasize cure and care aspects of nursing work rather than coordination.

All of the 7 intensive care units were located in the same category even though they were from three different hospitals. The 3 surgical units which loaded greater than .50 in the category with the intensive care units were from a University Teaching hospital in the city. It is possible that these particular surgical units might handle more "complex" surgical cases than other surgical units, because they are within a teaching hospital, making them more similar to intensive care units.

Auxiliary and psychiatric units appearing together in one category is also understandable from the nursing viewpoint. Generally the focus in both these types of units is upon socio-psychological needs of patients and their longer-term behavioural modification. Also, psychiatric nurses are of the opinion that they can contribute to patient recovery as therapists independent from psychiatrists (Strauss, 1975, p. 82). In auxiliary units, because of the long-term nature of

of patients' illnesses, the nurses also function somewhat independently from physicians. Again, because of the long-term nature of chronic diseases, the nurses tend to develop goals for patient care which emphasize patients' maintaining their independence as long as possible. In this way, the tasks of the nurses focus upon modifying patients' behaviour, thus, making the work of these sub-units similar to psychiatric units. These characteristics are supported by the previous analysis which ordered psychiatric and auxiliary units relatively high in uncertainty. Neither types of units in general admit patients with critical patho-physiological needs. In most hospitals this is specified as part of the formal or informal admission policy of psychiatric and auxiliary units, and to some degree explains their relatively low ordering on instability.

The auxiliary units and psychiatric units grouped together in the same category irrespective of whether the sub-units were located within general acute care hospitals or in hospitals specializing in psychiatric or auxiliary care.

The grouping of paediatric, obstetrical, surgical and rehabilitation units together in one category also has a reasonable interpretation. Generall speaking, these units are concerned with meeting both patients' socio-psychological and patho-physiological needs. In nursing terms, the functions of the nurses on these types of units are more those of a generalist; that is, covering a wider range of functions than in the other two categories of sub-units. For example, on a given day, a nurse working in any of these types of sub-units might be assigned several patients for whom to provide nursing care, some requiring physical care, some psychological care, and some

critical and some in non-critical conditions. From the ordering of the sub-units shown in Figure 3, paediatrics, obstetrics and rehabilitation were ordered relatively close together on all three factors, relatively low on uncertainty and in the middle on instability and variability. This suggested that on the whole, the work on these units was more routine and generalized, than psychiatry, auxiliary and intensive care.

Oblique Q technique was also applied which allowed the three categories to correlate. The solution resulting from the oblique analysis indicated that the basic grouping of the types of units within each category was similar to the results of the orthogonal analysis; however, the categories were correlated, and there was a tendency for units to load highly in more than one category. The oblique primary factor structure solution is shown in Table 5

Category I resulting from the oblique analysis was very similar to category I in the orthogonal analysis, since the same paediatric, obstetrical, surgical and rehabilitation units, loaded highly in category I in both the oblique and orthogonal solutions. No psychiatric or intensive care units loaded highly in this category in either analysis.

Category II in the oblique analysis, as in the orthogonal analysis, comprised all the auxiliary and psychiatric units, however, there were also a number of units which loaded highly in both category I and II. These were: 9 of the 14 paediatric units; 3 of the 8 obstetrical units; and all of the 10 possible rehabilitation units. These high loadings in both categories suggested that the more generalist tasks of paediatrics, obstetrical and rehabilitation units, may sometimes be more like the independent (from the physician) functioning and behavioural

TABLE 5

Q Technique-Oblique Primary Factor Structure Solution

Continued

Type of Sub-unit	Categories I	II	III	Type of Sub-unit	Categories I	II	III
PAEDS	0.805	0.409	0.251	SURG	0.825	0.399	0.417
PAEDS	0.832	0.709	0.245	SURG	0.793	0.371	0.248
PAEDS	0.848	0.340	0.121	SURG	0.663	0.123	0.677
PAEDS	0.783	0.579	0.156	SURG	0.665	0.255	0.650
PAEDS	0.587	0.374	0.487	SURG	0.676	0.274	0.634
PAEDS	0.305	0.368	0.576	SURG	0.703	0.230	0.535
PAEDS	0.803	0.725	0.192	SURG	0.646	0.404	0.379
PAEDS	0.867	0.581	0.148	SURG	0.580	-0.070	0.626
PAEDS	0.748	0.460	0.389	SURG	0.804	0.443	0.087
PAEDS	0.850	0.670	0.184	SURG	0.849	0.487	0.276
PAEDS	0.841	0.548	0.052	AUX	0.479	0.835	-0.106
PAEDS	0.549	0.585	0.475	AUX	0.462	0.896	-0.037
PAEDS	0.522	0.623	0.243	AUX	0.519	0.892	-0.001
PAEDS	0.867	0.548	0.362	AUX	0.433	0.820	-0.101
OBS	0.833	0.566	0.195	AUX	0.530	0.793	-0.142
OBS	0.717	0.375	0.001	AUX	0.439	0.847	-0.113
OBS	0.574	0.406	-0.036	AUX	0.237	0.820	-0.001
OBS	0.712	0.381	-0.134	AUX	0.479	0.808	-0.027
OBS	0.638	0.507	0.240	AUX	0.626	0.764	0.032
OBS	0.744	0.484	0.174	AUX	0.378	0.779	0.079
OBS	0.424	0.384	0.458	PSYCH	0.261	0.735	-0.071
OBS	0.818	0.638	0.182	PSYCH	0.381	0.775	-0.240
REHAB	0.593	0.659	0.027	PSYCH	0.470	0.775	-0.177
REHAB	0.504	0.719	-0.281	PSYCH	0.425	0.707	-0.047
REHAB	0.568	0.653	-0.229	PSYCH	0.391	0.838	-0.085
REHAB	0.712	0.588	0.013	PSYCH	0.364	0.842	-0.028
REHAB	0.644	0.725	0.165	PSYCH	0.436	0.746	-0.296
REHAB	0.780	0.742	0.137	PSYCH	0.444	0.737	-0.298
REHAB	0.809	0.769	0.048	ICU	0.159	-0.097	0.723
REHAB	0.681	0.763	0.064	ICU	0.079	-0.287	0.834
REHAB	0.793	0.756	-0.051	ICU	0.223	-0.001	0.837
REHAB	0.668	0.628	0.001	ICU	0.150	-0.077	0.900
SURG	0.810	0.385	0.354	ICU	0.140	-0.116	0.835
SURG	0.801	0.334	0.319	ICU	0.184	-0.154	0.860
SURG	0.773	0.101	0.417	ICU	0.106	-0.097	0.870
SURG	0.750	0.289	0.172				

CORRELATIONS:	I	II	III
I	1.00		
II	.57	1.00	
III	.24	-0.08	1.00

Note. The units and category loadings are shown in two groups for ease of presentation. The analysis was performed on the data from all 71 units together.

[a] Loadings of .5 and greater are underlined.

modification work of the psychiatric and auxiliary units. The correlation between categories I and II was .57.

Category III from the oblique analysis basically comprised the intensive care units along with 5 of the 14 surgical units loading highly in category I. These surgical units were all from a teaching hospital in the city, and as explained previously were likely to have more complex surgical cases than some of the other surgical units. The high loadings of these surgical units in category III in the oblique analysis indicated that there are elements of their tasks which are similar to the high crisis intervention, technical work of intensive care units. The correlation between categories I and III was .24.

Categories II and III were comparatively independent with a coefficient of -0.08, this dramatically illustrated that psychiatric and auxiliary units were basically quite different from the intensive care units. As pointed out previously, this was to be anticipated since patients admitted to psychiatric and auxiliary units rarely are in acute patho-physiological states. Also, patients with primarily socio-psychological problems would rarely be admitted to intensive care units.

Discussion of the Results in Relation to Organizational Theory

Technological Factors

The results of the factor analysis procedures applied to the nursing unit data indicated that there were three independent technological factors for the sub-units investigated. These three factors explained 61% of the variance in unit responses, leaving 39% of the variance unexplained. The first relatively large factor, labelled

uncertainty, accounted for 26% of the variance. A second relatively large factor, labelled uncertainty, explained 23% of the variance. The third factor was comparatively small accounting for 12% of the variance, and this was called variability.

On close examination of the factor solution shown in Table I, the structure and pattern of the loadings indicate that relatively distinct elements of the three hypothesized dimensions of technology, raw materials, techniques and task interdependence, were located within each independent factor. This factor solution is somewhat different from the structure obtained by Lynch (1974, p. 354) who found three orthogonal factors of predictability of events, routineness of operations and insufficient knowledge. Lynch's factors corresponded with her hypothesized constructs and indicated that raw materials, techniques and knowledge were separable dimensions within the technological variable.

In this current investigation the three hypothesized dimensions of technology,raw materials, techniques,and task interdependence, did not appear as separate factors in the factor solution and therefore could not be considered independent as in Lynch's investigation. A conceptual summary of the inconsistencies between the three hypothesized technological dimensions and the three technological factors obtained in the analysis is shown in Figure 5.

Regarding the nature of raw materials, in the first factor, it was the degree to which patients were not understood which was important;for the second factor, the instability of patients was crucial; and for the third factor, the variability between patients was important.

Figure 5: Inconsistencies Between Hypothesized Technological Dimensions and Empirically Derived Factors.

	EMPIRICALLY DERIVED FACTORS		
HYPOTHESIZED DIMENSIONS	Uncertainty	Instability	Variability
Nature of Raw Materials	Not well Understood	Unstable	Variable
Nature of Techniques	Unanalyzable Care Practices	Analyzable Cure Practices	Individual-ized
Type of Task Interdependence	Within unit Coordination by feedback	With physicians Coordination by programming	With Patients Coordination by pre-planning

The type of nursing technique applied to alter raw materials appearing in association with the three salient characteristics of patients was different in each case. In factor I, where patients were not understood and therefore accompanied by uncertainty, the nursing techniques were also uncertain in their application, hence, search behaviour was unanalyzable. In factor II, where patients were unstable, the techniques centred upon the monitoring and treatment of patients' physiological instabilities. The use of equipment and procedures implied analyzable search behaviour. Where patients were variable in factor III, nursing techniques and decisions were also characterized by variability, implying individualized search behaviour. These findings of characteristic patients and associated nursing techniques, tend to suggest as Perrow pointed out (1970, p. 75), that the nature of raw materials and the type of technique to be applied to alter materials, form a stimulus-reponse set for individual workers. From the nursing viewpoint, this is a desirable feature, and was to some degree expected, since it implies that the nursing sub-units perceived the nursing care to be tailored to individual patients' needs.

In addition, this important finding of apparently strong homogeneity between the nature of patients and type of nursing techniques employed, pointed to the more fundamental underlying constructs which caused the items to load together on each factor. In the first factor, the underlying dimension was uncertainty, this was apparent in both materials and techniques; in the second factor, the underlying construct was instability in both patients and types of nursing techniques; and in the third factor the common thread was variability in patients and nursing care.

Another notable feature regarding the nature of nursing techniques in each factor is the manner in which they reflect the three aspects of nursing practice described by Mauksch (1966, pp. 109-137) as care, cure, and coordination. Care practices are inherent within the uncertainty factor, in that the tasks are primarily concerned with the independent (from the physician) nursing functions. The focus is upon providing comfort to patients and meeting their socio-psychological needs as opposed to attempting to correct a major pathological problem. In the instability factor, cure practices predominate, the emphasis being upon nursing practice as technical assistance to physicians. The aim is to monitor and treat patients' patho-physiological problems. In a less clear cut manner, the coordination aspects of nursing practice are found in the variability factor. Since both patients and techniques are variable, this is suggestive of an emphasis upon coordination aspects of nursing tasks.

These findings, that the nursing techniques appearing in each factor should so closely reflect the three areas of nursing practice, care, cure, and coordination were unanticipated since neither the research instrument or the investigation itself was intentionally designed to specifically identify these aspects.

Task interdependence, the third hypothesized dimension of technology for this investigation, did not separate out as a variable independent from technology as Lynch (1974, p. 342) had found. A specific type of task interdependence was found within each of the three technological factors. This finding would suggest that the type of task interdependence is built into the nature of the technology in the nursing units under investigation; further, it is in keeping with

the descriptions of nursing practices by Mauksch (1966, pp. 109-137) who implied that coordination of patient care is an intrical part of nurses' work.

In all three factors the results suggested that the nurses' work was dependent upon feedback from patients, which was in support of Thompson's concept (1967, p. 14) of an "intensive" technology. In the uncertainty factor, feedback was from changes in patients' conditions and moods; in the instability factor, feedback was implied by the need for frequent nursing observation of patients; in the variability factor, feedback was by including patients and families in discussions when nursing care was being planned.

Furthermore, the three mechanisms of coordination defined by Perrow (1967, pp. 198-199) as feedback, programming, and planning, appeared to be implicit in the three factors. The mechanism for coordination in the uncertainty factor was by feedback, and task interdependence was specifically within the nursing unit, in that the nurses relied upon each other for assistance in completing their work. In the instability factor the work of the nursing sub-unit was dependent upon physician input, as implied by the number of physicians involved in prescribing care, and the frequency of communication with physicians. Coordination, however, was suggested to be by programming since set procedures, equipment and tests were used. Where there was variability, as in factor three, the task interdependence of the nursing sub-unit appeared to be with patients and their families. The mechanism of coordination was by planning, that is, including patients in discussions when nursing care was being planned.

The nursing sub-units did not apparently perceive their task

interdependence with other nursing sub-units or service departments in the hospital to be of importance, since items concerned with these aspects of task interdependence did not load highly on any factor.

In concluding this discussion of the technological factors in relation to organization theory, the question may be raised as to why the factors did not reflect the three hypothesized dimensions as orthogonal factors, as might have been predicted from the findings of Lynch (1974) for the library departments. Several possible reasons are postulated. First, differences in the findings of the two studies may be due to the differences in the homogeneity of sub-units in each study. In Lynch's case, although the departments or sub-units were all libraries, they had different types of raw materials. In some departments the raw materials were clients, in some they were books, and in others, they were materials. When factor analysis was performed, a common thread which appeared to cause items to load together to form a factor was raw materials, operationalized as predictability of events (Lynch, 1974). In the current investigation, however, the sub-units were not only homogeneous in that they were all nursing sub-units, but in addition, they all had raw materials of basically the same genre, that is, all the units had patients. In the factor solution, then, some other underlying commonality had to be responsible for the items loading together to form independent factors.

Another possible reason for the difference in findings between the two studies may be because patients admitted to nursing units, generally speaking, do not know what nursing care or services will best meet their needs, and decisions about what techniques to apply are made by the health professionals. This may be in contrast to

libraries where it is suspected that clients generally know what services they require from the organization.

Further, from the results of this current investigation, nursing sub-units appear to be characterized by a high interrelationship between the nature of raw materials (patients) and the type of techniques (nursing) employed, and a heavy reliance of nurses' tasks upon feedback from patients. These characteristics may be sufficiently unique to nursing sub-units to have been responsible for the differences in factor solutions obtained in the two studies.

Lynch's technological scale was developed on the basis of indivudal workers' responses,while in the current investigation, the factor analysis procedures were applied to unit responses. It is possible that an individual person's view of technology is different from a sub-unit or departmental view of technology, and the different methodological approaches used in each investigation could be responsible for the differing outcomes.

Finally, Lynch included several other organizational variables in her investigation and it is not known to what degree the same factor structure might have been obtained if only technological dimensions had been investigated, as in the current research.

Relative Indeterminancy of Nursing Sub-units' Technologies

As was previously discussed, the degree of determinancy of technology is related to the availability of knowledge about cause and effect relationships for assessing and bringing about desired change in raw materials. All the concepts of technology reviewed for this research had a knowledge factor implicit in their definitions. Hasenfeld and English (1974, p. 280) suggested that human service

organizations may be generally characterized by indeterminant technologies, yet there may be a significant degree of difference in task indeterminancy even within a common professional role when it is broken down into bounded and differentiated sub-units as in this research. Where technologies are indeterminant, the knowledge base is incomplete and techniques are applied with limited reliability and validity. Often knowledge and techniques may be contradictory and as a consequence there is considerably uncertainty about what the outcomes of action will be. Where technologies are more determinant about cause and effect relationships, explicit courses of action may be provided for workers to follow, and the specialty may be more easily communicated and learned. (Hasenfeld and English, 1974, p. 280). These descriptions are in keeping with Perrow's contrast (1970, p. 75) between non-routine and routine technologies.

In this section, the results are discussed in terms of their implications for evaluating differences in the degree of indeterminancy of the technologies of the various types of nursing sub-units.

Uncertainty as Contributing to Indeterminancy. The characteristics of the raw materials and search behaviours for the uncertainty factor, along with the ordering of nursing sub-units are shown in Figure 6. (Although there were three hypothesized dimensions of technology, for ease of presentation, Figures 6, 7, and 8, are illustrative of only two dimensions, raw materials and techniques).

Nursing sub-units who ordered high on uncertainty suggest that their technologies are relatively indeterminant. Patients present complex problems which are not well-understood. For the psychiatric units, this may be because so little is known about psycho-

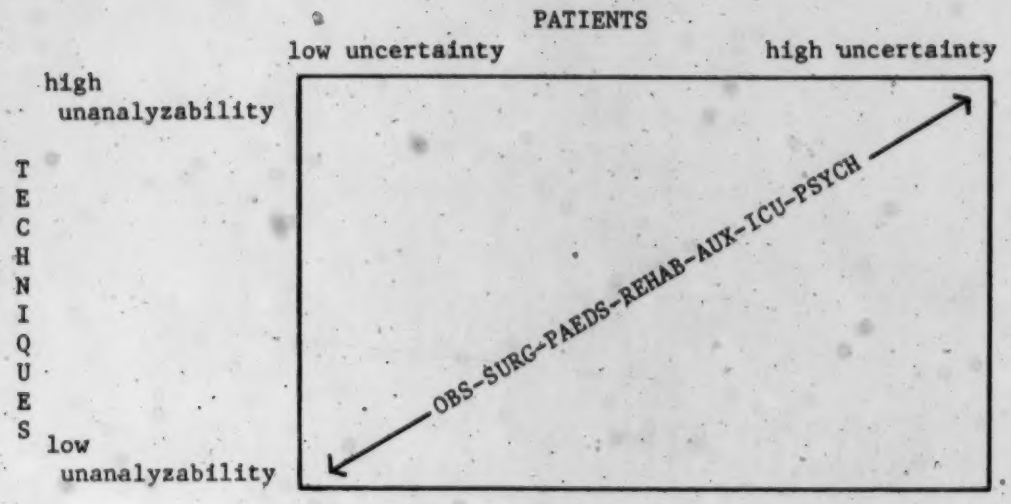


Figure 6. Uncertainty in Nursing Sub-units.

social diseases; for the intensive care units, because patients tend to present multiple problems and have psycho-social symptoms associated with their patho-physiological disorders; and in the auxiliary units, patients are generally incurable and/or aged with psycho-geriatric problems. The search behaviours involve the use of communication skills and emphasize the analysis of complex problems. Intuition is used frequently, indicating insufficient knowledge, and the work is relatively more dependent upon feedback from patients in relation to their conditions or moods. These search behaviours suggest that cause and effect relationships are unpredictable, with outcomes of nursing

care being relatively unknown. When exceptions occur, they are dealt with by the nurses using their own judgement and working as a team. The nursing sub-unit perceives itself as being instrumental in patient recovery and, in general, there is a heavy emphasis upon care practices (Wooldridge et al., 1969, p. 9), and independent (from the physician) nursing functions. The source of greater knowledge when needed is from patient feedback and from the nurses themselves. However, Wooldridge et al. (1968, pp. 12-20) pointed out that nursing guidelines for care practices are based mainly upon ideologies and therefore are not specific enough to do more than guide the individual nurses in a very general way in their day to day work. Since the nature of the problems presented to the nurses is relatively complex the uncertainty for the nurses is increased.

Nursing units ordering low on uncertainty suggest that their technologies are characterized by less indeterminancy than units ordering highly. For example, for the obstetrical, surgical, paediatric and rehabilitation units, this would imply that generally patients present fewer multiple and/or complex problems and there is less emphasis in the work upon analysis of complex problems. There is less reliance upon intuition as opposed to set procedures and the work is less dependent upon feedback from patients' conditions or moods. There is less independent (from physician) decision making, and in general, the nurses are less dependent upon each other's help to complete their work. It is implied that in these units that there is more knowledge available, and cause and effect relationships are believed to have greater predictability than in the nursing units ordering high on uncertainty. There are likely to be a greater number of nursing guidelines and

clearly specified techniques for the nurses to follow.

Instability as Contributing to Indeterminancy. The characteristics of the raw materials and search behaviour for the instability factor are shown in Figure 7.

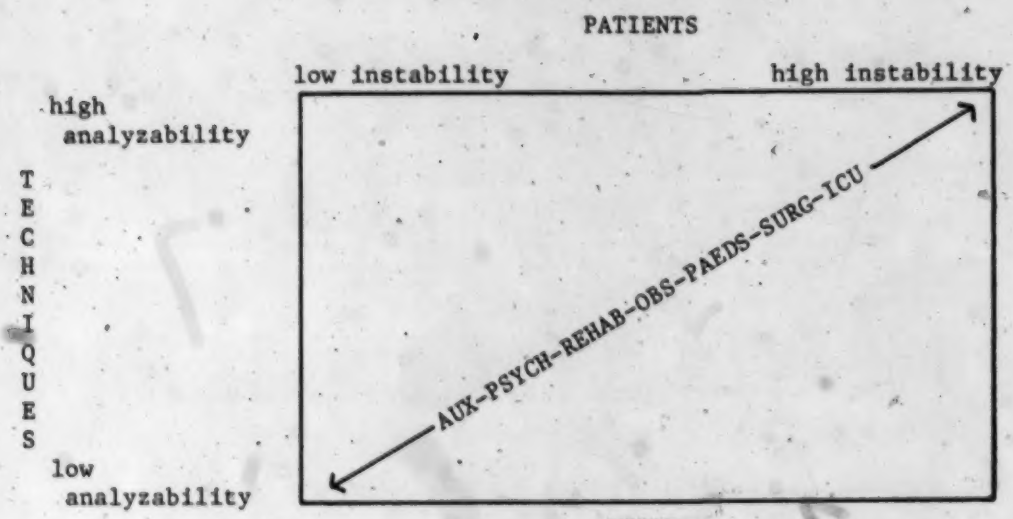


Figure 7. Instability in Nursing Sub-units.

Nursing sub-units ordering high on instability suggest they are characterized by indeterminant technologies, due to instability in patients' physiological conditions. This is confirmed by patients requiring frequent nursing observation, and the number of emergencies occurring. However, search behaviours are in general analyzable in that they involve the use of standardized nursing procedures and technical equipment. When exceptions occur, although there is high stress and time pressure, the work of the nurses is programmed, in that their primarily actions involve contacting the physician, since he is the source of greater knowledge and expertise. Generally speaking,

the focus of the tasks of nursing sub-units ordering high on this factor, is upon physician dependent functions and providing technical assistance to the physician. The emphasis is upon the use of cure techniques aimed to diagnose and treat patients' patho-physiological disorders. As Wooldridge et al. (1968, p. 9) point out, guidelines for cure practices are specified by physicians in considerable detail for the nurses. Accordingly, the search behaviours may be characterized by a relatively low degree of indeterminancy of technology for the nursing sub-units if not for the physicians.

Similarily, sub-units low on instability, such as auxiliary and psychiatric units, suggest that their patients are relatively less unstable and there are fewer patho-physiological emergencies. The nursing techniques involve fewer set procedures and technical equipment, lower task interdependence with physicians, and lower emphasis on cure practices.

Variability as Contributing to Indeterminancy. The distinctive features of the raw materials and search behaviours for the variability factor are shown in Figure 8.

Units ordering high in variability may be characterized by indeterminant technologies primarily because patients present a variety of problems to the nursing sub-units. The patients may or may not be unstable and uncertain. Search behaviours and decisions are variable suggesting that they are individualized for each patient. It is presumed that some search behaviours may be programmed, while others are unstandardized. The focus may be upon both socio-psychological and/or patho-physiological problems, and cause and effect relationships may be sometimes known and sometimes unknown. Feedback

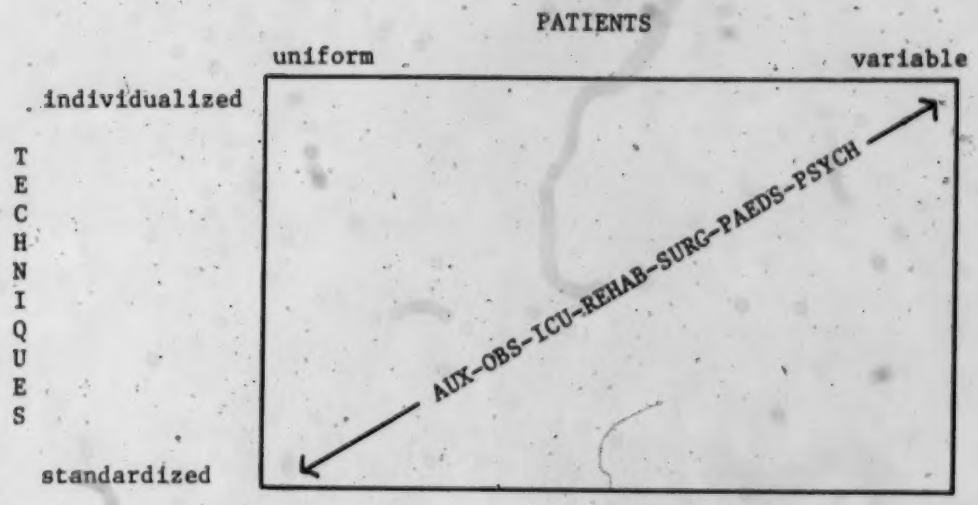


Figure 8. Variability in Nursing Sub-units.

appears to occur by pre-planning nursing care requirements with patients and families. This implies that patients and families are the source of greater information yet the need for the information can be pre-determined and routinized. Because of the variability in patients and in nursing techniques being used, coordination aspects of nursing practice may be emphasized. It is possible that this need to be a coordinator may be a source of indeterminancy for the units.

Indeterminancy of Categories of Nursing Sub-units. From the above discussion of the nature of the types of indeterminancies of technology described by each factor and the relative indeterminancies of the technologies of the various sub-units ordering high and low on each factor, some inferences can be made about the relative indeterminancy of the three categories of nursing sub-units obtained by the use of Q technique. For this discussion the assumption is made that

indeterminancy in nursing sub-unit technology can result from uncertainty, instability or variability, or a combination of these factors.

The intensive care units, in category III, are characterized by high indeterminancy in their technology, primarily due to high uncertainty and high instability in patients' conditions and nursing tasks. They are somewhat unique in that they emphasize both independent and dependent (on the physician) nursing functions. This finding is in keeping with Kovner's classification (1966, pp. 78-79) of intensive care units as units characterized by relatively high comlexity of technology.

The technology of psychiatric and auxiliary units, in category II, is indeterminant because of high uncertainty in patients' conditions and nursing tasks, and because of the importance of the nursing sub-unit in contributing independently (from the physician) to patients' recovery. Kovner (1966, pp. 78-79) classified psychiatric units as intermediate comlexity of technology.

In general, the units in category I, paediatrics, obstetrics, surgery and rehabilitation, are relatively low in indeterminancy in their technology. They are characterized by less uncertainty than the three other types of units. In addition, they have less instability in patients and nursing tasks than intensive care units, and less variability in patients and tasks than psychiatric units. Also, these units provide less technical assistance to physicians than intensive care units, and make fewer independent (from the physician) decisions than auxiliary and psychiatric units. Kovner's findings (1966, pp. 78-79) indicated that rooming-in (obstetrics) rehabilitation (2) and medical-surgical units rated relatively low in complexity of technology.

The correlations between the categories obtained from the use of oblique Q technique, however, indicate that paediatrics, obstetrical, surgical and rehabilitation units are not independent from the indeterminancy occuring in intensive care units, nor the indeterminancy occuring in psychiatric and auxiliary units. For example, the surgical units appearing in both category III and I (Table 5) suggested that their technology is also from time to time subject to a similar type of indeterminancy as intensive care units. This indeterminancy is more likely to be due to instability in these units rather than uncertainty since surgical units were ordered relatively high on instability, yet low on uncertainty.

The units appearing in both categories I and II, i.e. some paediatric, some obstetrical, and all the rehabilitation units (Table 5), suggested that these units are also subject to the same or similar indeterminancy as auxiliary and psychiatric units from time to time. The three auxiliary units, appearing in both categories I and II suggested that the work in these units is subject to the same type of relatively less indeterminancy of technology of paediatric, obstetrical, surgical and rehabilitation units.

The correlation between categories II and III was negligible ($r = -0.08$). This result suggested that the nature of the high indeterminancy of intensive care units and the nature of the indeterminancy of psychiatric and auxiliary units are independent; that is, these categories of units are randomly related when technology is viewed as a composite of uncertainty, instability and variability.

Some Implications of Relative Indeterminancy of Sub-unit Technology.

In principle, the relative indeterminancy of the various types of nursing tasks found in the study units may have implications not only for nursing administrators in hospitals, but also for nursing educators in schools of nursing.

The comparatively large category of units with relatively low indeterminant technologies suggested that there are a number of units namely, paediatrics, obstetrics, surgery and rehabilitation where cause and effect relationships are believed to have greater predictability, there is greater knowledge available and outcomes of nursing processes are relatively certain. It is implied that these nursing specialities are comparatively easy to learn and techniques do not outdate quickly. The functions of the nurses focus upon generalist nursing tasks rather than a highly specialized complex, narrow range of functions.

Where the technology of the nursing sub-units are characterized by higher indeterminancy, namely, intensive care, psychiatric and auxiliary units, it is suggested that cause and effect relationships are not well known, there is inadequate knowledge available and outcomes of care are uncertain. It is implied that these specialities are relatively difficult to learn and techniques outdate quickly.

Specifically, the type of expertise required in the psychiatric and auxiliary units is concerned with handling uncertainty. There is a high need for communicative skills, independent (from the physician) decision-making and an ability to analyze complex problems under stressful circumstances. In addition, the role of the nurse in this type of unit would appear to be primarily one of an independent (from

the physician) therapeutic agent for behavioural modification of patients.

In the intensive care units, since these are characterized by the greatest indeterminancies, nursing expertise is required in ability to handle not only uncertainty but also instability in the work. It appears that the nurses must be able to function as technical assistants to the physicians in curing patients patho-physiological disorders, and also as independent agents to assist patients with socio-psychological side effects resulting from the acuity of their physical states. The skills required then, by nurses in intensive care units are high communicative ability with patients and doctors, high technical skills and high decision-making ability. The nurses must also be able to work under time pressures and high stress.

The correlations between the categories of units suggested that the type of expertise required for psychiatric and auxiliary units and intensive care units may also be needed from time to time in the more generalist units of paediatrics, obstetrics, rehabilitation and surgery. Where the expertise required is like that of psychiatric and auxiliary units, for example, in obstetrical, rehabilitation and paediatric units, it will relate to handling uncertainty. Where the expertise required is like that of intensive care units, for example, in surgical units, it may not relate primarily to handling uncertainty but more likely to handling instability in the work. The implication here for nursing administrators is that some provision should be made available for providing the different types of specialized expertise to the more generalized units as necessary.

Discussion of the Construct Validity of the Measure

Since only one method of measurement of technology was used in this research, this discussion of construct validity of the measure is suggestive of the extent of construct validity rather than evidential. As indicated earlier, the criteria for assessing construct validity are convergence and discriminability.

From the results of the factor analysis there was some suggestion of convergence since items intended as indicators of the same attributes, for example, items 3, 4, and 5, correlated and loaded highly on the same factor. The propinquity of the solution to approach simple structure is also a manifestation of convergence of the measure. In the factor solution shown in Table I, there were 12 items which loaded greater than .50 on one factor and less than .20 on each of the other factors. Accordingly, this is suggestive of construct validity. The proportion of variance explained by the factor solution (61%), indicated that the major measurement of the instrument gave technological constructs. However, there remained 39% of variance unexplained, and as such is defined as error.

The extent to which the factor solution reflected the hypothesized dimensions of technology would suggest some construct validity for the questionnaire. Although the orthogonal factors obtained did not match the hypothesized dimensions in a clear cut manner, there were distinct elements of the three dimensions in each factor. This implied that to some degree the questionnaire did measure what it was intentionally designed to measure. In addition, the findings of the three aspects of nursing practice, cure, care and coordination within each factor indicated some validity of the measure

of technology for the nursing sub-units investigated.

A priori differences between the sub-units in terms of technology were expected and the analysis of variance procedures confirmed some of these expectations. The intensive care units appearing high in uncertainty and highest in instability were in keeping with the description of these types of units by Benner (1975, pp. 106-128). The psychiatric units ranking highest in uncertainty and variability were also in accordance with the description of psychiatric nurses' work by Strauss (1975, pp. 81-97). Cronbach and Meehl (1955, p. 287) indicated that when a priori differences are supported empirically this provides evidence of construct validity of measure.

The clear cut categorization of units that resulted from the use of Q technique, with the majority of units of the same type, loading highly into the same category, also was indicative of convergent validity of the measure. In addition, the proportion of variance explained by the three categories was 66% which was relatively high. The actual placement of the nursing sub-units in different technological categories not only fits nursing practice but also was in keeping with the categories described by Kovner (1966, pp. 78-79). The results of the Q technique must, however, be interpreted cautiously and cannot be generalized because of the greater number of variables (units) than subjects (items).

CHAPTER V

LIMITATIONS AND CONCLUSION

In this chapter the limitations of the research are described and the conclusions from the findings delineated. Also, some implications of the investigation for further research are explored.

Limitations

The investigation had a number of methodological limitations. First, the boundaries of the concept of technology in relation to other organizational variables are in general ambiguous, and this research made no attempt to assess the ability of the measure to discriminate between technology and other such variables. In addition, technology was operationalized in terms of hospital nursing technology and for the sub-unit level of analysis, and may therefore be inappropriate for use in other types of organizations or at other levels.

Only seven types of hospital nursing sub-units were included. Although these were the most common distinctive types, different factor structures might have been obtained with other types of units.

The number of nursing sub-units included was only 71 and these were not randomly selected. This limits the generalizability of findings, at most, to the population of the seven types of units in hospitals in Edmonton and district, since an attempt was made to obtain the total population of some types of units. However, because the total population of each type was not obtained, any generalizations of

the results must be made conservatively.

The method of measurement used was based upon the perceptions of technology by individual nurses and this approach is susceptable to measurement error. In terms of theory and proportion of variance in responses accounted for, the results of the factor analysis procedures producing the most satisfactory solution still left 39% of variance unexplained which must be considered as error. Perrow (1967) indicated that it is the perceptions of the workers of their work which is important, however, measurement of technology might be less open to error if objective data could be used in combination with perceptual data.

This research was also limited by the lack of hard evidence of validity of the measure of technology. Although as previously discussed, the findings were suggestive of some degree of construct validity of the measure, no real evidence of this was provided.

Conclusions

Three technological dimensions were hypothesized for this investigation: the nature of raw materials; the nature of techniques to alter raw materials; and the type of task interdependence. Three independent technological factors emerged from the factor analysis procedures. These factors were uncertainty, instability and variability, which did not match the three hypothesized dimensions of technology. Rather than raw materials, techniques, and task interdependence, appearing as independent constructs, distinctive elements of these three hypothesized dimensions were found within each analysed factor. For example, a specific type of nursing technique was found in each factor in association with and matching a specific type of patient.

Where patients had complex problems which were not well understood, and were accompanied by uncertainty, the nursing techniques were also concerned with analysis of complex problems and were uncertain in their application. Where patients were unstable in relation to their physiological states, the nursing techniques were also concerned with the monitoring, testing and treating of patho-physiological instabilities Where there was much variability in the health problems patients presented, the nursing techniques were also characterized by variability. In each of these situations the application of the nursing techniques relied upon feedback in relation to patients conditions and/or moods.

These findings were somewhat different from the empirical findings of Lynch (1974), since her work suggested that the three critical underlying dimensions of organizational technology for libraries were: predictability of events (raw materials); routineness of operations (techniques), and insufficient knowledge (knowledge), and that these dimensions were comparatively independent. In this investigation, raw materials and techniques were undoubtedly of importance and homogeneous, however, the nature of the technological factors obtained indicated that there were more fundamental underlying dimensions of technology for the nursing sub-units which produced the resulting factor solution. These factors were identified as uncertainty, instability and variability.

The findings of this study are nevertheless in keeping with Perrow's conceptual framework (1967), since he emphasized that understandability, instability and variability, are crucial dimensions of technology. However, he referred to these characteristics primarily in relation to raw materials and indicated that these may determine

characteristics of other aspects of technology such as the nature of techniques and the degree of knowledge available. Perrow (1967) implied that there might be a high interdependence between the technological dimensions and our findings are suggestive of this type of interdependence. It is suspected that nursing sub-units are likely to be characterized by a higher degree of interdependence between raw materials and techniques than some other types of organizations. Two major reasons are suggested. First, a decision to apply a particular nursing technique may be a "life or death" type, since the decision may be made in response to patients' patho-physiological and/or psychological emergencies. Second, all nurses are socialized in that the care they give to patients must be individualized, and tailored to meet specific patients' needs. These somewhat unique features of nurses' work imply a heavy reliance of nursing tasks upon feedback from patients. This feedback, then is postulated,as the most likely phenomenon responsible for uncertainty, instability, and variability,appearing so forcefully as the underlying technological factors in this research.

Task interdependence, in the findings of this investigation, could not be considered a separate variable from technology. A specific type of task interdependence was found within each factor. Where there was uncertainty, task interdependence was within the nursing sub-unit. Where there was instability, task interdependence was with physicians. Where there was variability, task interdependence was with patients and families. Mechanisms for coordination were different for each situation and were in keeping with Perrow's (1967) types of coordination. In uncertainty, coordination was primarily by feedback; in instability, coordination was mainly by programming; and in

variability, coordination was primarily by planning.

The three aspects of nursing practice defined by Mauksch (1966) as care, cure and coordination, were distinguishable as three independent areas of nurses' tasks within each factor. These findings were unexpected since the research had not been specifically designed to identify or measure these areas of nursing practice. Care practices were found in association with uncertainty, cure practices were inherent in instability, and coordination aspects of nursing practice were implicit in variability.

It was possible to differentiate between the types of nursing sub-units in terms of the three technological factors obtained. In relation to uncertainty, the units basically divided into three groups. Intensive care and psychiatric units were relatively high; auxiliary units were moderately high; paediatrics, obstetrical, surgical and rehabilitation units were relatively low. Regarding instability, the units divided into six groups. Intensive care units were highest, followed by surgery, paediatrics, obstetrics, and by rehabilitation and psychiatry together. Auxiliary units were lower than the other types of units in relation to instability. In terms of variability the units divided into three groups. Psychiatric units were higher than any other type of unit. Paediatric, surgical and rehabilitation units were moderately high. Intensive care, obstetrical and auxiliary units were relatively low in variability.

From the application of Q technique, which grouped the nursing sub-units according to their technologies as a whole rather than by independent factors, three categories of nursing sub-units were obtained. The grouping of the units was meaningful not only from

the nursing perspective, but also was explainable on the basis of the differences in units in relation to the independent factors of uncertainty, instability and variability.

From the orthogonal analysis, intensive care units were alone in one category with relatively high indeterminancy of their technology. The high indeterminancy was due to high uncertainty and high instability. Psychiatric and auxiliary units grouped together in another category with relatively indeterminant technologies. In this case, the indeterminancy was primarily due to uncertainty. Paediatric, obstetrical, surgical and rehabilitation units, appeared together in another category with relatively low indeterminancy in their technologies. This low indeterminancy was because of generally relatively low uncertainty, and only moderate instability and variability in these units as a whole.

The oblique analysis suggested, however, that these categories were not independent. Some of the paediatric and obstetrical units, and all of the rehabilitation units, have indeterminancies in their technology which are similar to the indeterminancies found in auxiliary and psychiatric units. In addition, some surgical units are characterized by indeterminancies in their technology which are similar to intensive care units. This latter similarity was primarily due to instability in these types of units.

Some Implications for Further Research

As a result of our findings it is suggested that the study be replicated with a wider range of types of nursing sub-units and a randomly selected sample of a greater number of sub-units of each type. (See pp.52-53 for the rationale for the number of units required to obtain statistical power).

The construct validity of the measure of technology should be investigated by measuring technology by additional subjective methods, and where possible objective measures should be considered. Some of these measures may be obtained from existing records and documents of nursing sub-units, capital equipment, etc.

It would also seem valuable to investigate differences in manpower and physical facilities occurring in various types of sub-units and to evaluate the appropriateness of existing arrangements in relation to the degree of indeterminancy in technology.

Further research in nursing sub-units might be directed towards the study of relationships between technology and other aspects of the sub-units. Variables such as structure, satisfaction and stress might be included, to further evaluate the discriminant validity of the measure of technology, and to allow for clearer specification of the boundaries of the technological concept. In addition, the relationship between technology and structure might be examined, particularly with regard to the quality of nursing care, patient recovery, nurses' satisfaction and organizational stress.

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APPENDIX A

Pretest Instrument and Factor Solutions

HOSP. _____

UNIT _____ 117.

NUMBER _____

QUESTIONNAIRE

This questionnaire is part of a study attempting to analyze the complexity of work done by nurses on various nursing units in hospitals. We would appreciate your answering the questions and giving your opinions on the kind of work you are doing on the nursing unit to which you are presently assigned. Some of the questions are complex; however, it would be helpful if you could attempt to answer all items. Thank you.

A. What is your present position?

__ head nurse or charge nurse
__ assistant head nurse or assistant charge nurse
__ RN/staff nurse/general duty nurse
__ registered psychiatric nurse
__ certified nursing aide
__ nursing orderly
__ other (please specify) _____

B. What is your level of nursing education completed? (Check more than one, if applicable)

__ Master's degree
__ Bachelor's degree
__ one year post-basic diploma
__ clinical post-graduate course (please specify the speciality) _____
__ RN diploma
__ RPN diploma
__ CNA certificate
__ nursing orderly certificate
__ other (please specify) _____

C. How many total years of nursing experience have you had since you graduated?

__ less than 1 year
__ 1 year - 2 years 11 months
__ 3 years - 5 years 11 months
__ 6 years - 8 years 11 months
__ 9 years or more

D. How long have you worked on this unit? _____

E. Do you usually work a certain shift, or do you rotate shifts?

__ day
__ evening
__ night
__ rotate

PLEASE CHECK THE ANSWER WHICH BEST REPRESENTS YOUR OPINION ABOUT THE WORK ON YOUR NURSING UNIT.

1. What sex is the majority of patients on your unit?

__ female __ male __ an even number of male and female

2. What age group(s) are frequently on your unit? (Check more than one, if necessary.)

__ under 1 year
__ 1-12 years
__ 13-19 years
__ 20-40 years
__ 40-60 years
__ over 60 years

3. What is the reason for admission of most of the patients?

__ diagnosis __ treatment __ a combination

4. What percentage of patients in this unit needs nursing observation more frequently than once every half hour?

__ less than 5% __ 5-25% __ 25-50% __ 50-75% __ more than 75%

5. Approximately how often do "emergencies" happen (i.e., when immediate nursing action must be taken in response to changes in patients' conditions)?

__ more than once a shift
__ about once a shift
__ once every day or two
__ about once a week
__ less than once a week

6. Some patients are admitted to hospital because they have one main health problem, others because they have several inter-related health problems. About what percentage of patients on your unit has more than one health problem?

__ less than 5% __ 5-25% __ 25-50% __ 50-75% __ more than 75%

7. What is the most frequent prognosis of patients on your unit?

__ health improvement __ health maintenance __ health deterioration

8. How easy is it to predict the length of stay of your patients?

__ very easy __ easy __ difficult __ very difficult

9. The importance of knowing details of a patient's previous health history can vary. For most of the patients on your unit, would you say:

__ detailed history from birth to present time is important?
__ summary of major health problems from birth to present is important?
__ history relating to present admission only is important?
__ little or no knowledge of previous history is necessary?

10. How frequently do you have patients on your unit with unique or unusual health problems?

__ very infrequently __ infrequently __ average frequency __ frequently __ very frequently

11. Considering all the types of patients with varying health problems on your unit, how often would you say you are able to predict the variety of patients that will be admitted?

__ very infrequently __ infrequently __ average frequency __ frequently __ very frequently

12. What percentage of the patients on the unit at a given time would you say has similar types of health problems?

__ less than 5% __ 5-25% __ 25-50% __ 50-75% __ more than 75%

13. How frequently are nurses required to perform technical procedures and special tests?

__ very infrequently __ infrequently __ average frequency __ frequently __ very frequently

14. What percentage of the patients at a given time requires an intravenous infusion?

__ less than 5% __ 5-25% __ 25-50% __ 50-75% __ more than 75%

15. What percentage of the patients at a given time requires the use of technical equipment (i.e., suctions, cardiac monitors, respirators, etc.)?

__ less than 5% __ 5-25% __ 25-50% __ 50-75% __ more than 75%

16. To your knowledge, are your patients ever hooked up (on line) with computers?

__ often __ occasionally __ never

17. How frequently are nurses required to make nursing "judgment" decisions? (independent of doctors' orders)

__ very infrequently __ infrequently __ average frequency __ frequently __ very frequently

18. When there is more than one method available for giving nursing care, what percentage of the time are you free to choose the method you think best?

__ less than 5% __ 5-25% __ 25-50% __ 50-75% __ more than 75%

19. How often are patient conferences held?

__ once a shift, or more frequently
__ once a day
__ once every two or three days
__ once a week
__ once a month, or less frequently

20. Relative to other nursing skills (such as technical or decision-making), how important is it that you have effective communication skills?

__ more important than other skills
__ same importance as other skills
__ less important than other skills

21. How much emphasis is placed on patient teaching?

__ high emphasis __ average emphasis __ below average emphasis

22. Relative to other units, how important is it for nurses on your unit to keep "emotionally distant" from patients?

__ more important than other units
__ same importance as most other units
__ less important than most other units

23. What percentage of nursing care on your unit is directed at meeting patients' socio-psychological needs?

__ less than 5% __ 5-25% __ 25-50% __ 50-75% __ more than 75%

24. What percentage of nursing care on your unit is directed at meeting patients' physiological needs?

__ less than 5% __ 5-25% __ 25-50% __ 50-75% __ more than 75%

25. How frequently in your work do you use only one skill (technical, decision-making or communication, etc.) as opposed to a variety of skills?

__ very infrequently __ infrequently __ average frequency __ frequently __ very frequently

26. Relative to other units, how quickly do present nursing care techniques become outdated?

__ more quickly than most other units
__ same as most other units
__ less quickly than most other units

27. On some units the nursing care given to patients varies in intensity during different shifts. On your unit, would you say that the intensity of nursing care given is

__ the same on all shifts? __ different on different shifts?

28. How frequently are there written objectives in the nursing care plan (Kardex)?

__ very infrequently __ infrequently __ average frequency __ frequently __ very frequently

29. For how many of the patients admitted are you able to follow standard admission routines?

__ almost all __ some __ almost none

30. For how many of the patients discharged are you able to follow standard discharge routines?

__ almost all __ some __ almost none

31. Is there a nursing procedure book available for use on your unit? __ Yes; __ No.
If Yes, how frequently would you say it is referred to?

__ very infrequently __ infrequently __ average frequency __ frequently __ very frequently

32. How much of your nursing care relies upon intuition rather than on set procedures or routines?

__ less than 5% __ 5-25% __ 25-50% __ 50-75% __ more than 75%

33. In your estimation, what percentage of nursing procedures is similar for most patients?

__ less than 5% __ 5-25% __ 25-50% __ 50-75% __ more than 75%

34. How frequently are the decisions you make during your work repetitive from one day to the next?

__ very infrequently __ infrequently __ average frequency __ frequently __ very frequently

35. How often does your work require the analysis of complex problems?

__ very infrequently __ infrequently __ average frequency __ frequently __ very frequently

36. How frequently do you have patients on your unit with complex problems that are not well-understood?

__ very infrequently __ infrequently __ average frequency __ frequently __ very frequently

37. In your opinion, is the amount of nursing knowledge available about what type of nursing care is required

__ adequate to handle most patients?
__ adequate to handle some patients?
__ inadequate to handle most patients?

38. How easy is it to learn the nursing care speciality of this unit?

__ easier than most other units
__ same as most other units
__ more difficult than most other units

39. Working on some units produces a higher stress environment for nurses. Is the stress level on this unit

__ higher than most other units?
__ same as most other units?
__ less than most other units?

40. On some units there is a greater pressure to give nursing care quickly because of patients' critical conditions. Is the time pressure on this unit

__ higher than most other units?
__ same as most other units?
__ less than most other units?

41. How easily can you predict your daily workload?

__ very easily __ easily __ with difficulty __ with much difficulty

42. In this unit, how heavily does improvement in patients' conditions really have to depend upon the skillful work and initiative of nursing personnel?

__ very heavily __ heavily __ not too heavily __ not heavily at all

43. Which of the following techniques are used on your unit to evaluate the effectiveness of nursing care? (Check more than one, if applicable.)

__ nursing audit
__ nursing standards
__ recording costs
__ nurses' discussions of the quality of care
__ follow-up of patients after discharge
__ other (please specify) _____
__ no techniques used to your knowledge

44. How frequently do you have verbal or written communication with the following groups:

medical staff (attending physicians, consultants, medical students, etc.)
__ many times a day
__ a few times a day
__ a few times a week
__ a few times a month
__ rarely

45. other nursing units
__ many times a day
__ a few times a day
__ a few times a week
__ a few times a month
__ rarely

46. service departments (x-ray, lab, social service, physio, dietary, laundry, CSR, etc.)
__ many times a day
__ a few times a day
__ a few times a week
__ a few times a month
__ rarely

PLEASE CHECK THE APPROPRIATE BOX.

	Very little	Little	Some	Almost all
47. How much of your work depends upon receiving doctors' orders first?	☐	☐	☐	☐
48. How much of your work must be completed before a doctor can do his work?	☐	☐	☐	☐
49. How much of your work depends upon another nursing unit doing its work first?	☐	☐	☐	☐
50. How much of your work must be completed before another nursing unit can do its work?	☐	☐	☐	☐
51. How much of your work depends upon service departments (lab, x-ray, laundry, dietary, etc.) doing their work first?	☐	☐	☐	☐
52. How much of your work must be completed before service departments can do their work?	☐	☐	☐	☐
53. How much of your work depends upon another nurse within the unit doing her work first?	☐	☐	☐	☐
54. How much of your work must be completed before another nurse within the unit can do her work?	☐	☐	☐	☐
55. For how much of your work do you need another nurse to work along side you?	☐	☐	☐	☐
56. How much of the time are patients included in discussions when their nursing care is being planned?	☐	☐	☐	☐
57. How much of your work depends upon your patients' conscious co-operation?	☐	☐	☐	☐
58. How much does your work change in response to changes in patients' conditions or moods?	☐	☐	☐	☐

TABLE A

Pre-test Factor Solution - 58 Items

Orthogonal Solution Varimax Rotation
(Loadings greater than .6 are underlined)

Item No.	Item Content	Communalities	Factors 1	2	3
1	Pt. variability - age	0.247	0.386	0.221	-0.223
2	Pt. variability - sex	0.159	-0.196	-0.283	-0.202
3	Pt. variability - reason for admission	0.221	-0.050	0.467	0.020
4	Pt.instability - observation (Kovner)[a]	0.516	0.047	0.639	0.326
5	Pt.instability - emergency (Kovner)	0.148	-0.200	0.155	0.289
6	Pt. variability - No. of problems	0.316	0.299	0.464	0.105
7	Pt. variability - prognosis	0.167	-0.354	-0.117	0.167
8	Pt.instability - length of stay	0.562	0.309	0.682	-0.032
9	Pt.instability - history	0.348	0.536	0.247	-0.014
10	Pt. variability - type of problem	0.228	0.242	0.300	0.282
11	Pt. variability - type of problem (Lynch)	0.173	-0.032	0.399	-0.114
12	Pt. variability - type of problem (Lynch)	0.261	0.113	0.448	-0.218
13	Skill - technical	0.253	-0.284	-0.232	0.344
14	Skill - technical	0.492	-0.689	-0.119	-0.056
15	Skill - technical	0.076	-0.256	0.002	-0.102
16	Skill - technical	0.136	-0.076	-0.268	0.242
17	Skill - judgment (Kovner)	0.215	0.460	-0.012	0.059
18	Skill - judgment	0.315	0.499	-0.187	-0.178
19	Skill - judgment	0.382	0.590	0.156	0.093
20	Skill - communication (Kovner)	0.499	0.657	0.250	0.070
21	Skill - communication	0.181	0.309	0.074	0.284
22	Skill - communication	0.157	-0.011	-0.371	-0.140
23	Care - socio-psych	0.686	0.737	0.369	-0.078
24	Care - physical	0.093	-0.128	-0.135	0.242
25	Skill - variety	0.059	0.102	-0.195	0.102
26	Techniques - outdate	0.286	0.033	0.522	0.113
27	Care - change with time of day	0.108	0.309	-0.073	-0.088
28	Care - objectives	0.483	0.309	0.611	-0.120
29	Procedures - admission	0.181	-0.183	0.380	0.050
30	Procedures - discharge	0.099	0.088	0.302	0.001
31	Procedures - manual	0.174	0.386	-0.136	-0.085
32	Procedures - intuition (Kovner)	0.557	0.627	0.398	0.067
33	Procedures - dissimilarity (Lynch)	0.418	0.445	0.368	-0.291
34	Decisions - non-repetitive (Lynch)	0.421	0.037	0.562	-0.322
35	Care - complex problems	0.651	0.639	0.475	0.131
36	Care - problem not understood	0.459	0.571	0.364	0.002
37	Care - knowledge insufficient (Kovner)	0.185	0.295	0.239	0.204
38	Care - difficult to learn (Kovner)	0.456	0.288	0.602	-0.191
39	Tasks - stress high	0.550	0.005	0.728	0.141
40	Tasks - time pressure high	0.377	-0.566	0.026	0.237
41	Work load - unpredictable (Lynch)	0.153	0.152	0.354	0.069
42	Role - patient improvement (Kovner)	0.534	0.367	0.630	0.045
43	Care - evaluation methods	0.287	0.279	0.306	0.340
44	Communication - doctors (Kovner)	0.270	0.438	-0.019	0.279
45	Communication - other units (Kovner)	0.205	0.005	-0.112	0.439
46	Communication - service depts. (Kovner)	0.016	-0.116	0.014	0.045
47	Task interdependence - doctors (Lynch)	0.167	-0.282	0.110	0.274
48	Task interdependence - doctors (Lynch)	0.217	-0.093	0.302	0.343
49	Task interdependence - other units(Lynch)	0.556	-0.156	-0.552	0.477
50	Task interdependence - other units(Lynch)	0.271	-0.151	0.073	0.493
51	Task interdependence - service depts. (Lynch)	0.287	-0.258	-0.193	0.429
52	Task interdependence - service depts. (Lynch)	0.436	0.020	-0.123	0.649
53	Task interdependence - within unit(Lynch)	0.423	0.251	0.207	0.564
54	Task interdependence - within unit(Lynch)	0.458	0.224	0.044	0.637
55	Task interdependence - within unit(Lynch)	0.437	0.382	0.268	0.469
56	Task interdependence - feedback patient	0.535	0.542	0.484	0.085
57	Task interdependence - feedback patient	0.421	0.415	-0.452	0.213
58	Task interdependence - feedback patient	0.469	0.680	0.080	0.004
		18.442	7.465	7.060	3.917

[a]Source of modified item.

TABLE B

Pre-test Factor Solution - Condensed Questionnaire
Orthogonal Solution Varimax Rotation
(Loadings greater than .6 are underlined)

Item No.	Item Content	Communalities	Factors		
			1	2	3
1	Pt. instability- length of stay	0.537	0.362	<u>0.636</u>	-0.022
2	Pt. instability- history	0.362	0.563	0.212	-0.011
3	Care - socio-psych.	0.725	<u>0.798</u>	0.294	-0.045
4	Techniques - outdate	0.294	0.106	0.499	0.184
5	Care - objectives	0.475	0.373	0.575	-0.075
6	Procedures - intuition	0.593	<u>0.668</u>	0.373	0.083
7	Decisions - non-repetitive	0.494	0.038	<u>0.617</u>	-0.335
8	Care - difficult to learn	0.521	0.297	<u>0.652</u>	-0.085
9	Tasks - stress high	0.610	0.032	<u>0.747</u>	0.225
10	Tasks - time pressure high	0.450	<u>-0.623</u>	0.128	0.214
11	Role - patient improvement	0.570	0.426	<u>0.620</u>	0.060
12	Care - evaluation methods	0.410	0.352	0.242	0.477
13	Communication - doctors	0.432	0.526	-0.147	0.365
14	Pt. variability (1,2)[a]	0.171	-0.047	0.343	-0.226
15	Pt. instability/variability (4,5,6,10)	0.499	0.182	0.539	0.419
16	Pt. variability (11,12)	0.232	0.125	0.460	-0.068
17	Skill - technical (13,14,15)	0.422	<u>-0.621</u>	-0.131	0.136
18	Skill - judgment (17,18,19)	0.536	<u>0.730</u>	-0.044	0.027
19	Skill - communication (20,21)	0.456	<u>0.626</u>	0.132	0.217
20	Procedures dissimilar (29,30)	0.231	-0.069	0.474	0.031
21	Procedures dissimilar (31,33)	0.406	0.562	0.193	-0.232
22	Care - problem analysis (35,36)	0.620	<u>0.667</u>	0.405	0.104
23	Task interdependence - other units (45, 49,50)	0.600	-0.133	-0.358	<u>0.674</u>
24	Task interdependence - doctors (47,48)	0.376	-0.232	0.263	0.503
25	Task interdependence - service depts. (51,52)	0.621	-0.177	-0.226	<u>0.734</u>
26	Task interdependence - within unit (53, 54,55)	0.413	0.288	0.177	0.547
27	Task interdependence - feedback patient (56,57,58)	0.631	<u>0.772</u>	0.119	0.141
		12.685	5.652	4.477	2.556

[a] Original questionnaire item numbers.

TABLE C
Pretest Factor Solution -
Integrated Condensed Questionnaire and Nursing Care Plan Analysis
Orthogonal Solution Varimax Rotation
(Loadings greater than .6 are underlined)

Method	Item No.	Item Content	Communalities	Factors 1	2	3
Q	1	Pt.instability - length of stay	0.468	0.505	0.404	0.223
	2	Pt.instability - history	0.346	0.520	0.249	0.114
U	3	Care - socio-psych.	0.636	0.746	0.260	-0.111
	4	Techniques - outdate	0.095	0.219	0.142	0.164
E	5	Care - objectives	0.337	0.468	0.385	0.141
	6	Procedures - intuition	0.553	0.733	0.090	0.013
S	7	Decisions - non-repetitive	0.379	0.099	0.054	0.605
	8	Care - difficult to learn	0.393	0.373	0.203	0.462
T	9	Tasks - stress high	0.395	0.109	0.605	0.132
	10	Tasks - time pressure high	0.248	-0.486	-0.068	-0.084
I	11	Role - patient improvement	0.494	0.563	0.379	0.185
	12	Care - evaluation methods	0.421	0.469	0.331	-0.301
O	13	Communication - doctors	0.419	0.393	0.270	-0.437
	14	Pt. variability (1,2[a])	0.335	-0.070	0.437	0.373
N	15	Pt. instability/variability(4,5,6,10)	0.290	0.265	0.467	-0.043
	16	Pt.Variability (11,12)	-.324	0.223	0.499	0.160
N	17	Skill - technical (13,14,15)	0.555	-0.696	0.216	-0.133
	18	Skill - judgment (17,18,19)	0.344	0.575	0.062	-0.096
A	19	Skill - communication (20,21)	0.399	0.620	0.073	-0.093
	20	Procedures (29,30)	0.077	-0.098	0.261	0.011
I	21	Procedures (31,33)	0.455	0.596	-0.121	0.293
	22	Care - problem (35,36)	0.500	0.589	0.380	-0.094
R	23	Task interdependence - other units (45,49,50)	0.561	-0.172	-0.215	-0.697
E	24	Task interdependence - doctors (47,48)	0.114	-0.200	0.212	-0.169
	25	Task interdependence - service depts. (51,52)	0.451	-0.185	-0.061	-0.643
	26	Task interdependence - within unit (53,54,55)	0.399	0.427	0.025	-0.464
	27	Task interdependence - feedback pt. (56,57,58)	0.556	0.734	0.119	-0.056
N	28	Variation in age	0.585	0.243	0.720	0.088
U	29	Variation in marital status	0.239	0.341	-0.077	0.343
R	30	Variation in stay	0.355	0.586	-0.070	0.084
S	31	Range of first diagnosis	0.335	-0.257	0.249	0.456
I	32	Range of second diagnosis	0.376	-0.005	-0.612	0.043
N	33	Variation in no. of second diagnoses	0.404	-0.474	-0.552	0.264
G	34	Amount of close observation	0.179	-0.046	-0.233	0.350
	35	Variation in close observation	0.429	-0.509	-0.080	0.405
C	36	No. of needs identified	0.497	-0.037	-0.703	0.041
A	37	No. of tests and procedures	0.469	-0.543	-0.417	-0.016
R	38	No. of different medications	0.138	-0.227	0.255	0.148
E	39	No. of different 'plans of action'	0.334	0.327	-0.465	0.106
	40	Percentage of care - socio-psych.	0.555	0.691	-0.248	-0.133
A	41	No. of medical consultants	0.522	0.592	-0.316	0.413
N	42	Frequency of medical consultations	0.389	0.447	-0.374	0.224
A	43	No. of nurses involved	0.493	-0.362	-0.549	-0.244
L						
Y			16.894	8.237	5.140	3.516
S						
I						
S						

[a]Original questionnaire item numbers.

APPENDIX B

Questionnaire to Nurses

DIVISION
HEALTH SERVICES ADMINISTRATION
TELEPHONE (403) 432-8407 AND 432-8408

THE UNIVERSITY OF ALBERTA
EDMONTON, ALBERTA, CANADA
T6G 2G3

TO NURSING STAFF:

This questionnaire is part of a study attempting to compare the complexity of work done by nurses on various units in hospitals. We would appreciate your opinions on the kind of work that is done by nursing staff on the unit to which you are presently assigned. Even though some of the questions are complex, it would be helpful if you could attempt to answer all items, checking (✓) the answer which most closely represents your opinion.

In almost all questions you are asked to estimate a percentage:

Each question has five choices for your answer:

0 - 5%
6 - 25%
26 - 50%
51 - 75%
76 - 100%

Example: Assume a nurse answered Question 12 in the following manner:

12. How many of the patients on your unit on an average day require an intravenous infusion?

	0-5	6-25	26-50	51-75	76-100
%	✓				

This nurse has indicated that on her unit, no patients or no more than 5% of the patients on average require intravenous infusions.

Thank you for your assistance

Peggy Overton
Division of Health Services Administration
University of Alberta
Edmonton, Alberta

May, 1975

HOSPITAL _____ UNIT _____ NUMBER _____

	% 0-5	6-25	26-50	51-75	76-100
1. In your estimation, what percentage of patients on your unit need nursing observation more often than once every half hour?					
2. How many of the patients would you say have similar health problems (or diagnosis)?					
3. Some patients are admitted to hospital because they have one main health problem, others because they have several inter-related health problems. What percentage of the patients on your unit has multiple health problems?					
4. For some patients more than other it is important to know complete details of their previous health history. For how many of the patients on your unit is it critical that the nurses know a detailed history from birth to present time?					
5. What percentage of the patients on your unit has complex problems that are not well understood?					
6. For how many of the patients can you predict their length of stay on your unit?					
7. What percentage of the time is patient teaching highly emphasized on your unit?					
8. What percentage of the nurses' work involves performing technical procedures and special tests?					
9. How much of the time are patient conferences held on a daily basis?					
10. What percentage of patients require the use of technical equipment (i.e. suctions, cardiac monitors, respirators, etc.)?					
11. When there is more than one method available for giving nursing care, what percentage of the time are you free to choose the method you think best?					
12. How many of the patients on your unit on an average day require an intravenous infusion?					
13. How many of the decisions made by nursing staff relating to direct patient care are made independent of doctors orders?					
14. Working on some units produces a higher stress environment for nurses. How much of the time would you say there is a high stress environment on your unit?					
15. On some units there is a greater pressure to give nursing care quickly because of patients' critical conditions. What percentage of the time is there a greater time pressure on your unit?					
16. What percentage of the time does improvement in patients' conditions really have to depend upon the skillful work and initiative of nursing personnel?					
17. How much of your work requires the analysis of complex problems?					
18. For how many of the patients are there written goals for individualized care in the Kardex (nursing care plan)?					
19. What percentage of the nursing care on your unit is directed at meeting patients' sociopsychological needs (as opposed to physical needs)?					

	0-5	6-25	26-50	51-75	76-100
20. What percentage of the nursing care given relies upon nurse's intuition rather than on set procedures or routines?					
21. How many of the nursing care procedures are similar for most of the patients on your unit?					
22. What percentage of the decisions the nurses make during their work are repetitive from one day to the next?					
23. What percentage of the present nursing care techniques used on your unit become quickly outdated?					
24. What percentage of new nurses starting work on your unit would find the nursing care specialty difficult to learn?					
25. How many of the patients and/or the families are included in discussions when their nursing care is being planned?					
26. How much of your work changes in direct response to changes in patients' condition or mood?					
27. What percentage of the time are you highly dependent upon other nurses in your unit for help and/or are they dependent upon your help?					
28. How much of the time is your unit highly dependent upon service departments (lab, X-ray, Laundry, Dietary, Pharmacy, Physiotherapy, Occupational Therapy etc.) and/or are the service departments dependent upon your unit to provide good patient care?					
29. How much of the time is your unit highly dependent upon another nursing unit(s) and/or is another nursing unit(s) dependent upon your unit to complete the required work?					
30. How many of the patients on your unit have more than one attending physician simultaneously prescribing care?					

31. How frequently do the nurses on your unit have verbal or written communication with medical staff (attending physicians, consultants, medical students, etc.)?

_____ many times a day,_____a few times a day,_____a few times a week, _____ a few times a month_____rarely.

32. Relative to other nursing skills (such as technical decision-making), how important is it that you have effective communication skills?

_____ more important than other skills_____same importance as other skills

_____less important than other skills.

33. Approximately how often do "emergencies" happen (i.e., when immediate nursing action must be taken in response to changes in patients' condition)?

_____ more than once a shift _____about one a shift_____once every day or so

_____ about once a week _____less than once a week.

34. What age group(s) of patients are frequently on your unit? (Check more than one, if necessary)

___ ___ ___under 1 yr._____1-12 years_____13-19 years_____20-40 years_____40-60yrs

_____over 60 years?

A. How many years of nursing experience have you had since graduation or training?

__ less than 1 year
__ 1 year - 2 years 11 months
__ 3 years - 5 years 11 months
__ 6 years - 8 years 11 months
__ 9 years or more

B. Please check one of the following:

RN(graduate nurse)_____

OTHER(RPN,CNA,CNO,NA, etc.)_____

Thank you for your assistance.